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Old Dominion Line's Freight Steamer Tyler

A single screw freight steamer, in which are incorporated some unusual features of design, has just been built for the Old Dominion Steamship Company, New York. by the New York Shipbuilding Company, Camden, N. J. The *Tyler,* as the new vessel is named, is fitted out entirely as a freight carrier; classed A-1 in the American Bureau of Shipping, and is the only vessel of the Old Dominion fleet that will be used exclusively for freight. Hitherto the service of this company between New York and Norfolk has been carried on by passenger ships, but with the advent of the new vessel the capacity of the line for handling miscellaneous freight expeditiously will be materially increased.

FIG. 1.—FREIGHT STEAMER TYLER FOR THE OLD DOMINION LINE

An unusual feature in the design of the vessel is the bulbous form of the bow, which was adopted after a series of model tests were made to determine the form which would best meet the requirements of the vessel for speed and power. This form of bow hitherto has been adopted only in the battleships and large cruisers.

The hull is built of steel throughout to the following dimensions:

Length over all	344 feet.
Length on waterline	331 feet.
Beam, molded	47 feet.
Depth, molded	26 feet 7 inches.
Depth, molded to hurricane deck	35 feet.

The hull is divided by five watertight bulkheads into six watertight compartments, and has four decks, namely, the orlop, lower, main and hurricane, with deck houses amidships. The propelling machinery is also located amidships. Details of the construction of the hull can be seen from the amidship section and general plans shown in Figs. 2 and 3.

Fourteen cargo ports are fitted, six between the lower and

main decks, port and starboard, and eight between the main and hurricane decks, port and starboard. Gangway doors are fitted abreast the large cargo hatches in way of the well forward. Large cargo hatches are also fitted to the forward and after holds with two freight elevators between the hold and the main deck and one freight elevator between the hold and the hurricane deck.

rant on the hurricane deck with leads running forward to the steering engine amidships.

General Arrangement

On the bridge deck, forward, there is a pilot house, aft of which are the captain's room and baths for both the captain and the officers; then a light and air shaft extending to the galley on the hurricane deck below. Aft of the air shaft on the

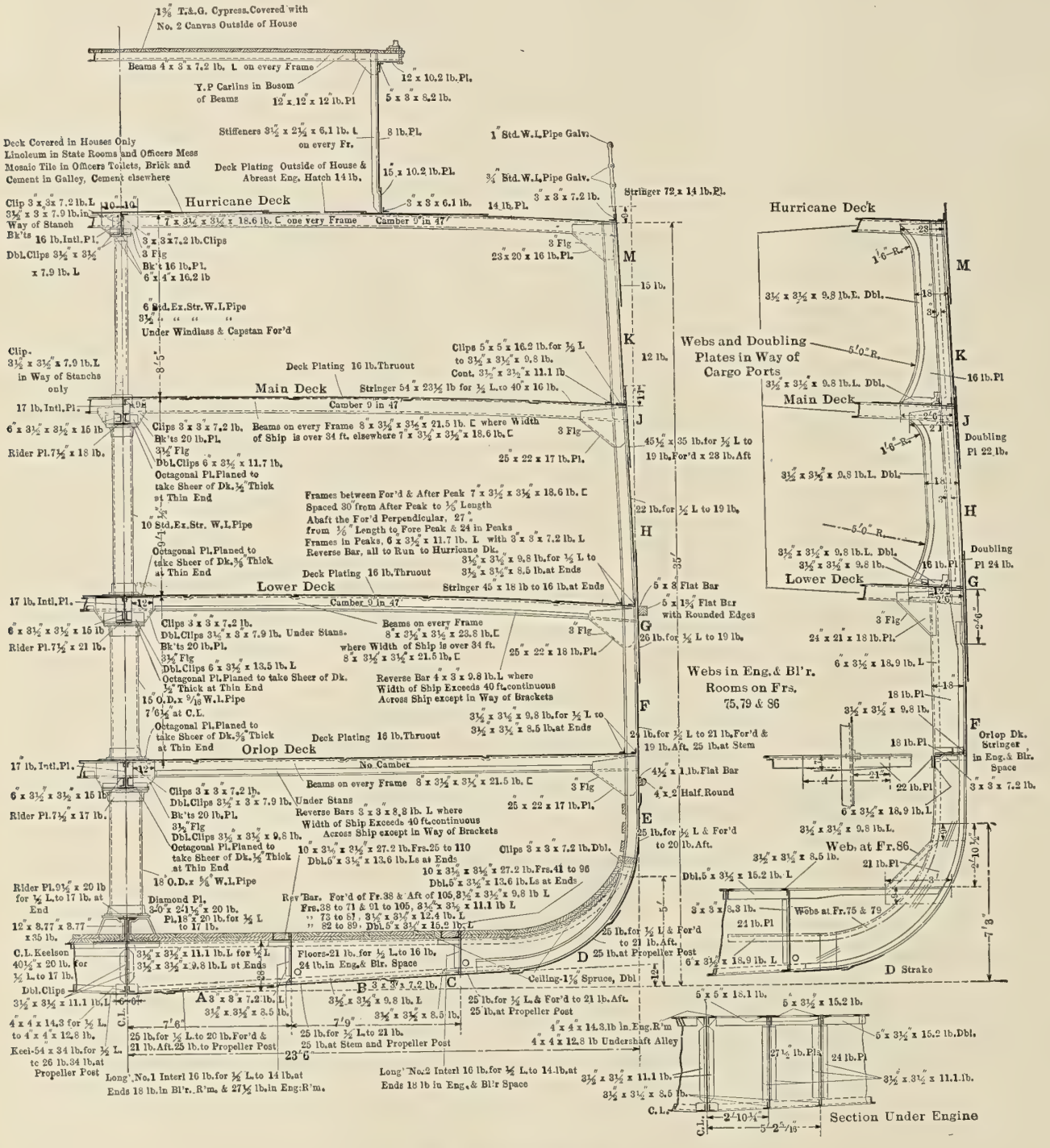

FIG. 2.—MIDSHIP SECTION

Freight is handled by two 10-ton steel booms on the foremast and one 3-ton and two 5-ton wooden booms on the mainmast. For working the cargo, four powerful Lidgerwood steam winches are fitted, two at the foremast and two at the mainmast, with smaller winches of the Lidgerwood type fitted at each elevator hatch to handle the lighter cargo. The remaining deck machinery consists of a Hyde windlass and capstan forward and two capstans aft. Steering is by a quadrant on the hurricane deck with leads running forward to the steering engine amidships.

On the bridge deck, forward, there is a pilot house, aft of which are the captain's room and baths for both the captain and the officers; then a light and air shaft extending to the galley on the hurricane deck below. Aft of the air shaft on the starboard side are the officers' quarters, and on the port side the wireless room and the quarters for the wireless operator and quartermaster, besides a spare stateroom on both the starboard and port sides.

Forward of the stack on the hurricane deck there are two separate houses with a passageway between; the forward one, which is 44 feet long and 24 feet wide, contains the officers' mess, aft of which are the stewards' quarters, refrigerators

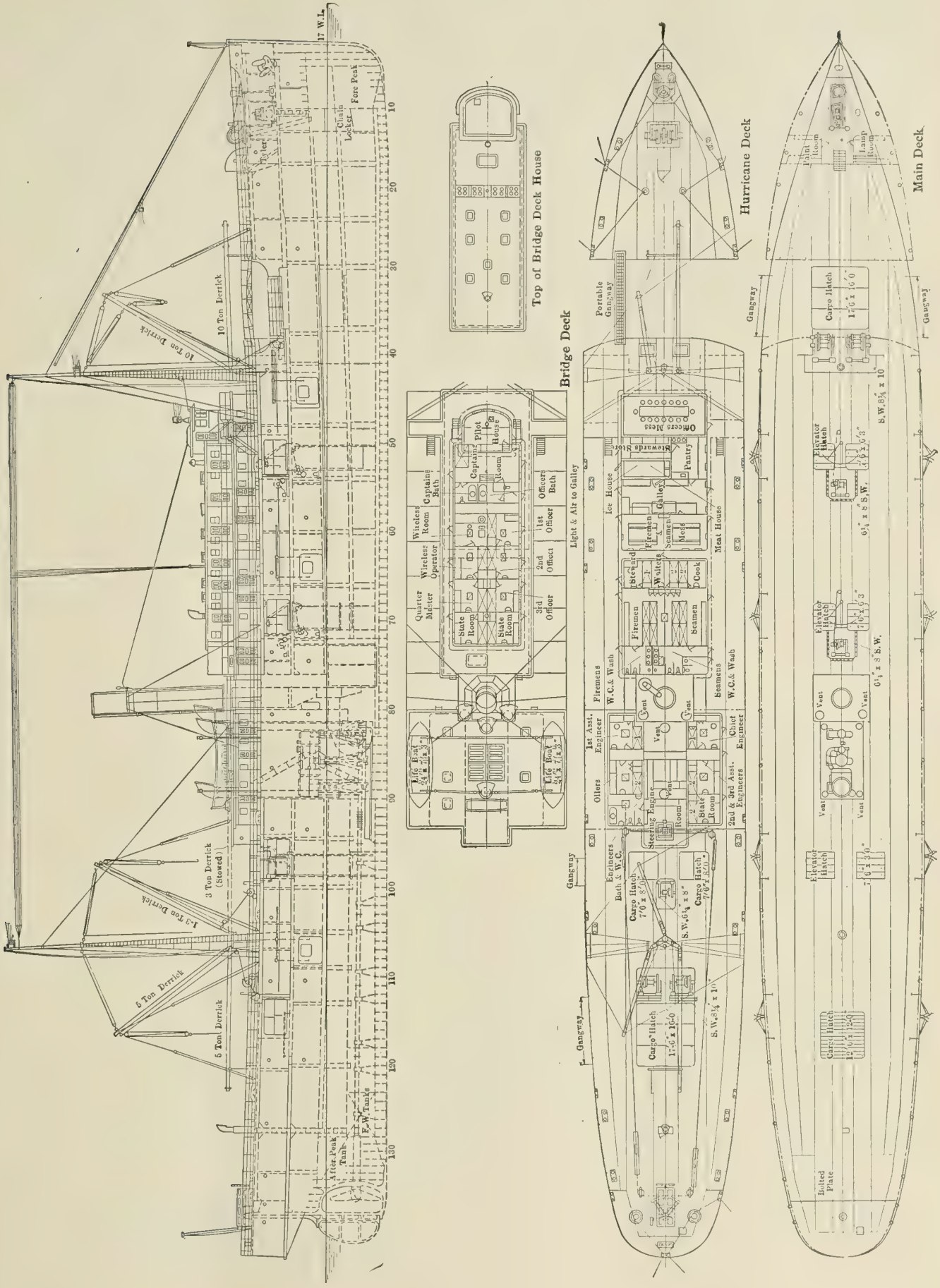

FIG. 3.—GENERAL ARRANGEMENT PLANS

and pantry and then the main galley, aft of which again are the firemen and seamen's mess. In the second deck-house on the hurricane deck are rooms for the steward, waiters, cook and quarters for the firemen and seamen.

Aft of the stack, and located around the engine room casing, are the rooms and baths for the engineers and oilers, together with a spare stateroom on the starboard side. Right aft of the engine casing is the steering engine room.

The main deck, with the exception of the engine and boiler casings, and fore and after peaks, is devoted exclusively to freight.

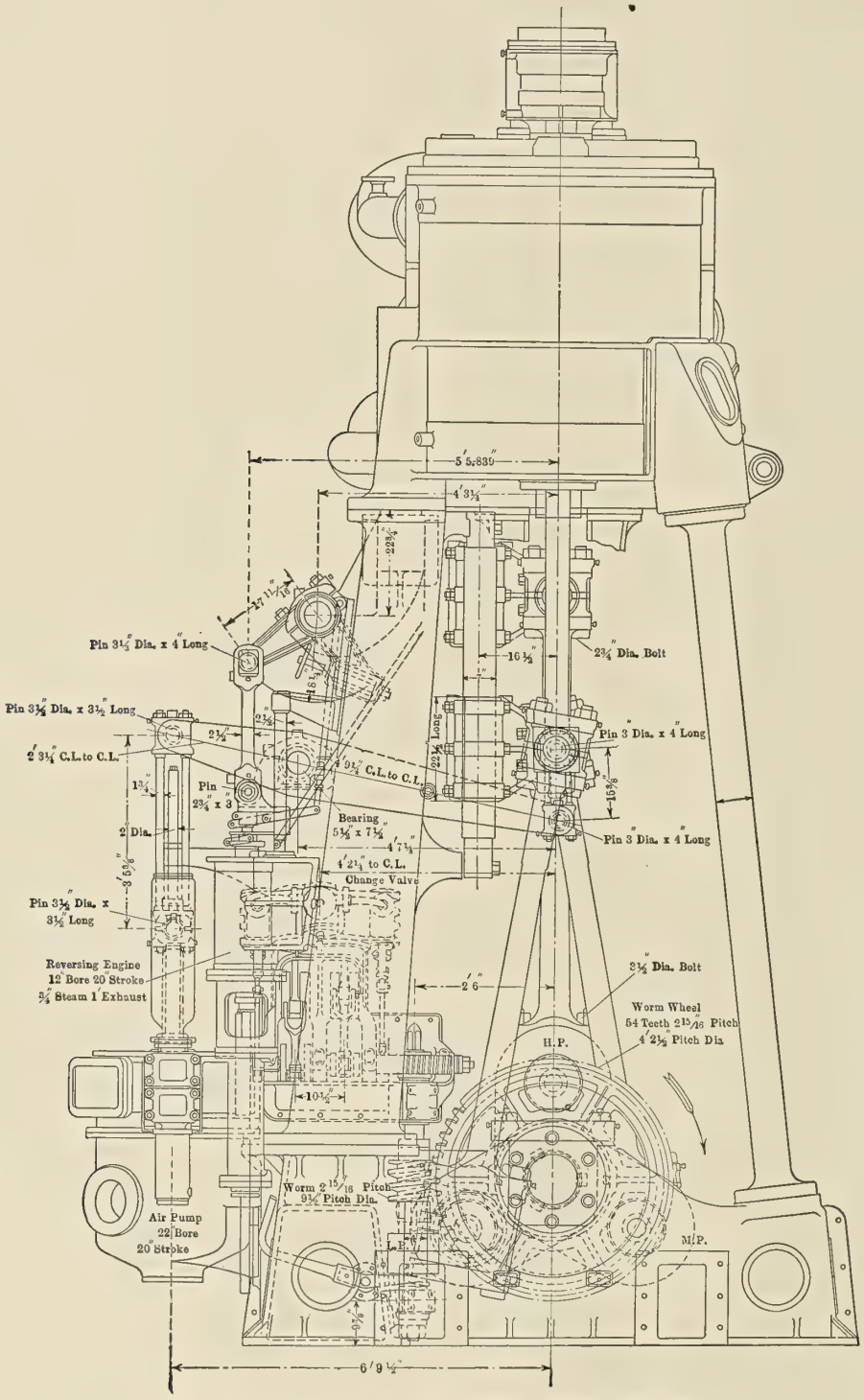

FIG. 4.—END ELEVATION OF MAIN ENGINE, LOOKING FORWARD

Propelling Machinery

Propulsion is by a single screw, driven by a three-cylinder, triple-expansion engine, 19¾, 33¼ and 58 inches diameter by 42 inches stroke, operating at a normal speed of 100 revolutions per minute. From the sectional drawings of the main engine, shown in Figs. 4 and 5, it will be noted that piston valves are fitted to the high-pressure and intermediate-pressure cylinders, being placed between the two cylinders, while a double-ported slide valve is fitted to the low-pressure cylinder, together with a Lovekin assistant cylinder. All of the piston rods are 5¼ inches diameter and the crankshaft 12 inches diameter.

The main air pump, 22 by 20 inches, together with two bilge pumps, 4½ by 20 inches, is worked off the intermediate-pressure crosshead. The main engine auxiliaries consist of a two-cylinder, 6 by 6 by 6-inch turning engine and a 12 by

20-inch reversing engine, with an oil cylinder 6¼ by 20 inches, and also an evaporating pump 1¾ inches by 9 inches, operated from the rocker arm of the main air pump.

Steam is supplied by two single-end Scotch marine boilers, 13 feet 6 inches diameter by 12 feet long, located in a single fire-room and separated from the engine room by a screen bulkhead. Coal is placed in wing bunkers abreast the boiler room on both the port and starboard sides, extending a short distance into the engine room. A vertical donkey boiler, 4 feet diameter by 8 feet high, is located on the main deck above the boiler room.

All the auxiliary machinery in way of pumps, heaters, filters, etc., are of a very complete and up-to-date character. On the starboard side of the main engine room is the engine-driven blower and a fresh water tank fitted with a 4½ by 2¾ by 6-inch horizontal Blake fresh water pump. On the port side of the engine room are the main condenser, with a 10-inch centrifugal circulating pump, driven by a 6 by 6-inch engine, together with the feed-water tank and a Schutte & Köerting feed-water heater. The main and auxiliary feed pumps are both of the Blake vertical type, 12 by 7 by 16 inches. The donkey boiler feed pump is a horizontal Worthington pump, 4½ by 2¾ by 4 inches. The other auxiliaries include a 14 by 8½ by 12-inch Blake donkey pump and a 6 by 6 by 12-inch Blake horizontal sanitary pump.

Fresh water is carried in built-in tanks aft. The trim of the ship is maintained by tanks in the forward and after peaks. The vessel was designed for a speed of 12 knots at sea, but

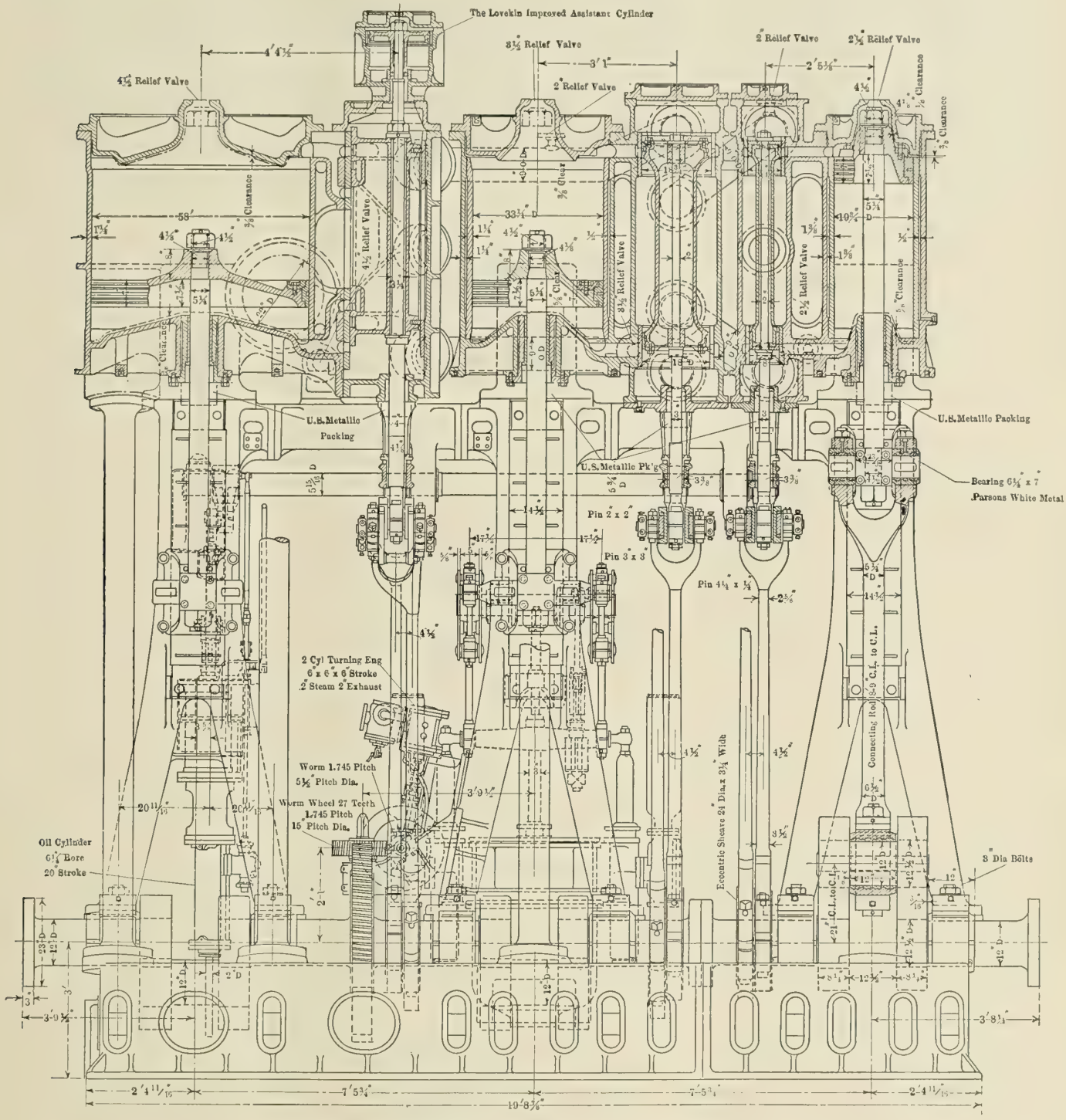

FIG. 5.—SECTIONAL ELEVATION OF MAIN ENGINE OF THE FREIGHT STEAMER TYLER

on her trial trip a speed of 12¾ knots was obtained with the vessel loaded to her designed draft and carrying between 2,600 and 2,700 short tons of freight.

Launch from the Middleton Shipyard

On Tuesday, July 8, Messrs. Irvine's Shipbuilding & Dry Docks Company, Ltd., launched from their Middleton shipyard the steel screw steamer *Manchester Civilian,* built for Messrs. The Manchester Liners, Ltd., Manchester.

The dimensions of the vessel are 400 feet in length by 52 feet beam extreme by 29 feet 6 inches depth molded, carrying over 8,000 tons on a moderate draft. She is built to British Corporation Classification, having a single deck of steel, with poop, bridge and forecastle, and water ballast is carried in the cellular double bottom and fore and afterpeak tanks, the tank under the engines and boilers being arranged for trimming.

The vessel is constructed with deep frames, without side stringers, giving exceptionally clear holds for the carriage of bulky cargoes, and is divided into seven watertight compartments by six transverse bulkheads. Wood grain divisions are fitted throughout to Board of Trade regulations. Four large hatches are provided and a cross bunker hatch, together with all the latest facilities for the rapid loading and discharging of cargo, including ten special type steam winches exhausting to a contraflo winch condenser, and twelve Mannesmann steel derricks. A powerful quick-warping steam windlass is fitted forward, and combined steam and hand-steering gear is fitted aft (Wilson & Pirrie type), with telemotor attachment to the bridge amidships.

The machinery, which has been constructed by Messrs. Richardsons, Westgarth & Company, Ltd., Hartlepool, consists of a set of "Richardsons" standard triple-expansion engines, with cylinders 25 inches, 40 inches and 68 inches by 48 inches stroke, steam being supplied by three large single-ended boilers, working under natural draft at a pressure of 180 pounds per square inch. The specification is very complete, and embraces contraflo main and auxiliary condensers, and a Cascade feedwater filter and heater, in which the whole of the auxiliary exhausts are utilized for feed heating. The auxiliaries include a Morison evaporator, large ballast pump, vertical auxiliary feed pump float, controlled from the Cascade filter, and independent pump for the auxiliary condenser. In the stokehold Diamond blowers are fitted for cleaning the boiler tubes, and the fire-doors and the furnace fittings are of special design.

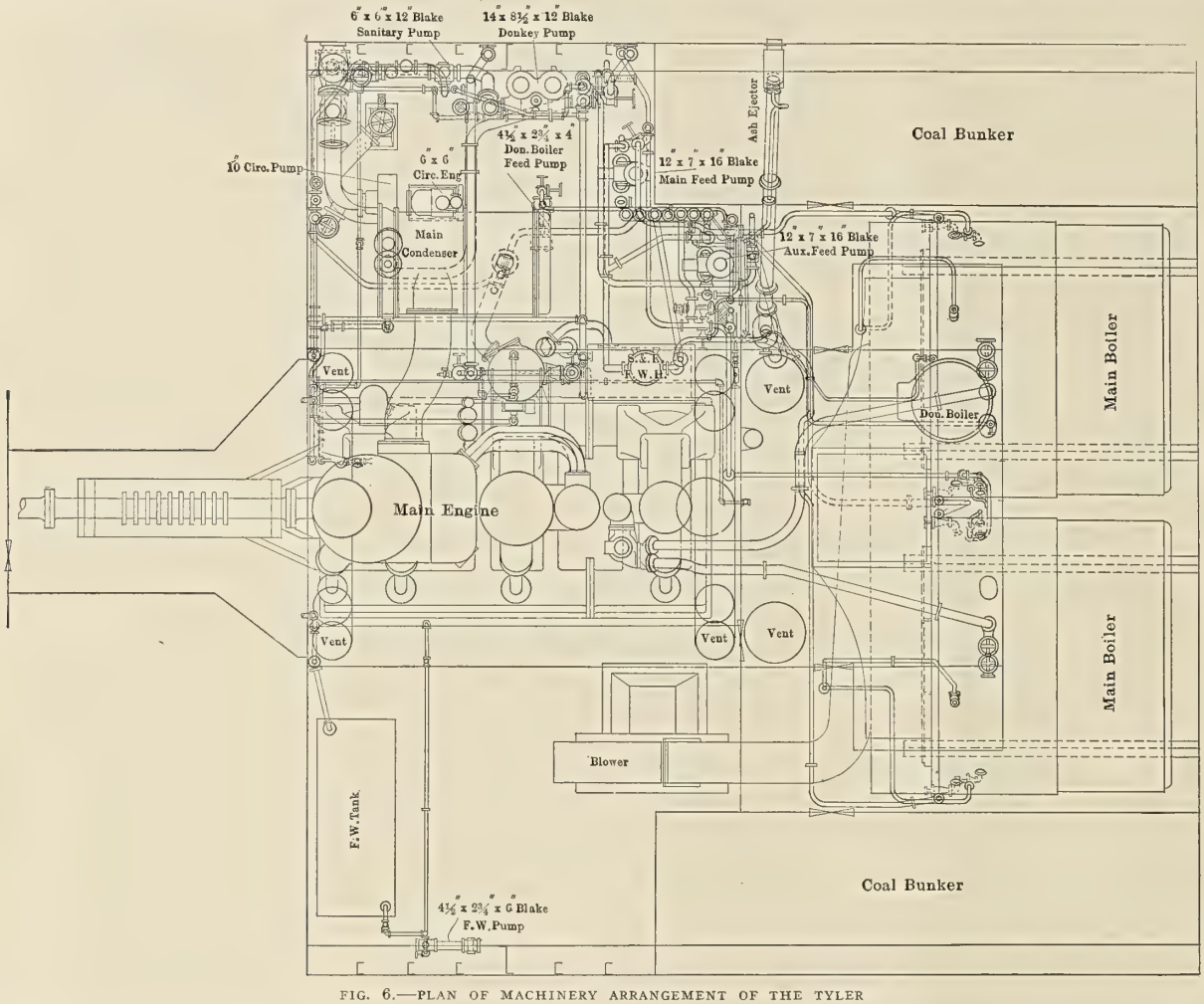

FIG. 6.—PLAN OF MACHINERY ARRANGEMENT OF THE TYLER

The propeller is of the solid four-bladed type, and made entirely of manganese bronze.

CHINESE SHIP BUILT TO AMERICAN RULES.—According to a report from the Consul-General at Hongkong, a twin-screw steel steamer, 217 feet in length over all, 38 feet beam and 12 feet depth, is being built in one of the Hongkong shipyards for non-American citizens and for use in non-American trade under the rules and specifications of the American Bureau of Shipping. The owners of the vessel are the Sze Yup Steamship Company, of Hongkong, and the vessel will be used in the trade between Hongkong and Kongmun, the Chinese port in the Pearl River Delta, which is the port for the districts from which the vast mass of the Chinese in the United States come. Accommodations will be provided on the ship for first class European passengers and first, second and third class Chinese passengers. There will also be ordinary accommodations for about 1,100 Chinese passengers, and the vessel will be finished in about eleven months. The company owns and operates three other vessels in their trade, but the other vessels were built to English specifications.

Progress of U. S. Naval Vessels

The Bureau of Construction and Repair, Navy Department, reports the following percentage of completion of vessels for the United States navy:

	Tons.	Knots.		May 1.	Aug. 1.
BATTLESHIPS					
New York....	28,000	21	Navy Yard, New York....	77.2	85.8
Texas	28,000	21	Newport News Shipb'g Co..	88.4	91.7
Nevada	28,000	20½	Fore River Shipb'g Co....	29.3	40.3
Oklahoma	28,000	20½	New York Shipb'g Co.....	26.0	37.7
Pennsylvania..	....	....	Newport News Shipb'g Co..	00.0	2.0
TORPEDO BOAT DESTROYERS					
Cassin	742	29½	Bath Iron Works.....	87.2	99.3
Cummings	742	29½	Bath Iron Works.....	81.2	90.4
Downes	742	29½	New York Shipb'g Co.....	47.5	63.7
Duncan	742	29½	Fore River Shipb'g Co....	79.0	98.0
Aylwin	742	29½	Wm. Cramp & Sons.....	92.1	96.9
Parker	742	29½	Wm. Cramp & Sons.....	89.2	93.5
Benham	742	29½	Wm. Cramp & Sons.....	87.9	92.3
Balch	742	29½	Wm. Cramp & Sons.....	88.5	91.8
O'Brien	742	29½	Wm. Cramp & Sons.....	1.3	7.1
Nicholson	742	29½	Wm. Cramp & Sons.....	1.2	7.3
Winslow	742	29½	Wm. Cramp & Sons.....	1.2	7.0
McDougal	742	29½	Bath Iron Works.....	4.4	12.6
Cushing	742	29½	Fore River Ship'g Co.....	8.9	12.6
Ericsson	742	29½	New York Shipb'g Co.....	5.0	9.6
SUBMARINE TORPEDO BOATS					
G-4	....	....	Wm. Cramp & Sons.....	88.4	93.4
G-2	....	....	Newport News Shipb'g Co..	87.2	88.1
H-1	....	....	Union Iron Works.....	90.4	94.5
H-2	....	....	Union Iron Works.....	90.0	93.0
H-3	....	....	Seattle Con. & D. D. Co...	88.0	91.4
G-3	....	....	Lake T. B. Co.....	67.4	69.6
K-1	....	....	Fore River Shipb'g Co....	76.6	85.9
K-2	....	....	Fore River Shipb'g Co....	76.8	85.0
K-3	....	....	Union Iron Works.....	75.6	81.6
K-4	....	....	Seattle Con. & D. D. Co..	75.0	78.6
K-5	....	....	Fore River Shipb'g Co....	58.7	72.9
K-6	....	....	Fore River Shipb'g Co....	57.1	72.7
K-7	....	....	Union Iron Works.....	65.3	71.9
K-8	....	....	Union Iron Works.....	63.4	71.0
L-1	....	....	Fore River Shipb'g Co....	00.0	6.1
L-2	....	....	Fore River Shipb'g Co....	00.0	6.1
L-3	....	....	Fore River Shipb'g Co....	00.0	6.1
L-4	....	....	Fore River Shipb'g Co....	00.0	5.5
M-1	....	....	Fore River Shipb'g Co....	00.0	00.0
COLLIERS					
Proteus	20,000	14	Newport News Shipb'g Co..	90.7	100.0
Nereus	20,000	14	Newport News Shipb'g Co..	87.1	93.6
Jason	20,000	14	Maryland Steel Co.....	98.8	100.0
Jupiter	20,000	14	Navy Yard, Mare Island..	99.1	100.0
Kanawha	14,000	14	Navy Yard, Mare Island..	00.0	1.3
Maumee	14,000	14	Navy Yard, Mare Island..	00.0	1.3

Mine Layers Cerbère and Pluton

The French admiralty has recently constructed two mine layers to take up the work carried on hitherto by old destroyers, which were altered for the purpose. The appearance of the new vessels resembles that of a big trawler, and they are so designed that the submarine mines, of which there are 140, are trimmed on the main deck on four railway lines, ready for launching through two specially large doors in the stern of the vessel. These mines, which are of the Sauter-Harle pattern, are so constructed that they will remain at a depth of 13 feet below the surface of the water. The boats are further armed by one 3-pounder gun, located forward.

The general dimensions of the boats are:

Length over all	199 feet 5 inches.
Length between perpendiculars	193 feet 7 inches.
Breadth	27 feet 3 inches.
Depth	14 feet 2 inches.
Draft at stern	10 feet 8 inches.
Displacement, full load	594 tons.
Displacement, on trial	541 tons.

The hulls are of Siemens-Martin steel, and the keel, 131 feet in length, of teak. On each side of the center keelson are five keelsons amidships, and towards the ends the number is reduced to three. Bilge keels, 10 inches deep, have been worked for about 80 feet amidships. The hull is divided into ten watertight compartments. The officers are berthed forward and the crew aft.

Steam is supplied to the main engines and auxiliaries by two watertube boilers, operated under forced draft. The main engines consist of two reciprocating engines, driving screw propellers. Particulars of the engines and boilers will be found in Table I. Electricity is supplied by a 4-kilowatt dynamo. A Thirion pump, with a capacity of 15 tons of water per hour, is also supplied.

It is worthy of note that the ordinary bunkers have been worked on both sides of the boiler rooms, and extra bunkers are located alongside the engine-rooms; therefore the vital parts of the ship are in a measure protected. Two rudders are fitted, one forward and one aft, having surfaces of 50 to 24 square feet, respectively.

Table I.—Boilers and Engines.

	Cerbère.	*Pluton.*
Boilers:		
Type	du Temple.	Normand.
Number	2	2
Grate surface	151 sq.ft.	148.55 sq. ft.
Heating surface	5,647	6,927
Pressure	256 pounds.	256 pounds.
Fans	2 Rateau.	2 Rateau.
Bunkers	145 to 190 tons.	145 to 190 tons.
Acting radius	1,900 miles at 16 knots.	
Main Engines:		
Diameters of cylinders	19, 29 and 48 ins.	19, 29 and 48 ins.
Stroke	23 ins.	23 ins.
Revolutions	260	260
Indicated horsepower	3,000	3,000
Propellers:		
Diameter	8 ft. 3 ins.	8 ft. 3 ins.
Pitch	9 ft. 4 ins.	9 ft. 4 ins.

Table II. Four-hour Full-power Trial.

	Cerbère.	*Pluton.*
Mean speed	20 knots.	20.87 knots.
Best run	21.695 knots.	21.50 knots.
Consumption, contract, per square foot grate, per hour	81 pounds.	81 pounds.
on trial	71 pounds.	77 pounds.
per indicated horsepower	1.80 pounds.	1.86 pounds.
Revolutions	278.10	272.4

Table III. Eight-hour Trial at 16 Knots.

Mean speed	16.45 knots.	16 knots.
Consumption, contract, per square foot grate, per hour	21 pounds.	21 pounds.
on trial	17 pounds.	17 pounds.
per indicated horsepower	1.20 pounds.	1.40 pounds.
Revolutions	202.5	192.5
Builders	Chantier de Bretagne.	Chantier A. Normand.

Performance of the Lumber-Carrying Steamer Adeline Smith

The steam lumber-carrying vessel, *Adeline Smith*, described on page 331 of INTERNATIONAL MARINE ENGINEERING for August, 1912, was built by the Newport News Shipbuilding Company, Newport News, Va., to the designs of Edward S. Hough, San Francisco, Cal., and is now on her regular runs between the Oregon lumber mills of the C. A. Smith Lumber Company, owners of the vessel, and their yards in San Francisco Bay. This steamer is, therefore, of special interest to those engaged in the lumber mill industry and transportation by water, inasmuch as she is a link which completes the chain of operations in one of the most systematic lumber companies at the present time.

By referring to the drawings published in the August, 1912,

issue, it will be noted that the vessel is not provided with cargo-handling gear, except for two booms forward, which are used to handle the company's mill freight only. The absence of cargo-handling gear is accounted for by the fact that at the lumber mills in Oregon, and at each of the extensive yards of the Smith company in San Francisco Bay, there are overhung electric travelers, with trolleys arranged so that the vessels

Hitherto it has been, and still is, the general custom for the seagoing lumber steamers to land their cargoes in lots as required at the different wharves convenient to or on the property of the lumber yards. This is a slow and expensive process for the vessel, and is entirely avoided by the system developed by the Smith company.

On the *Adeline Smith* the holds and decks are designed to

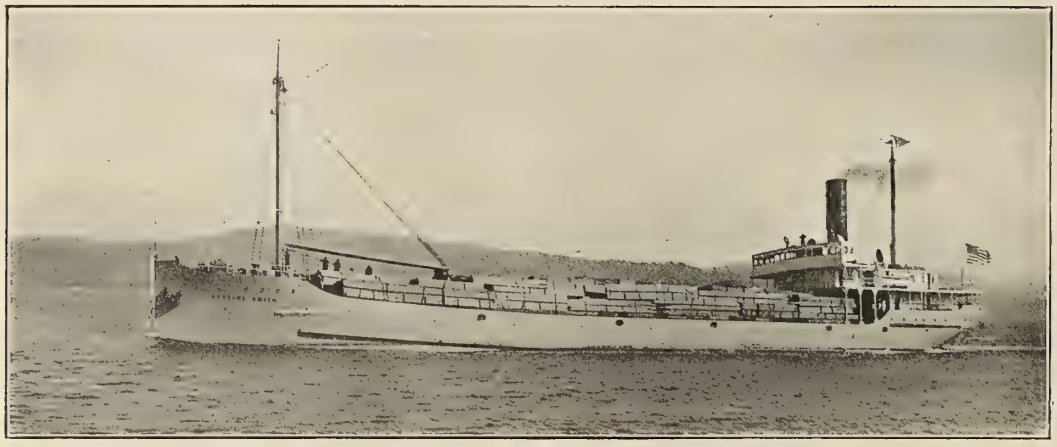

FIG. 1.—ADELINE SMITH, WITH CARGO OF LUMBER IN COOS BAY

can be loaded and discharged without the use of any gear on board.

The mill products of the Smith company are handled in units of standard size from the sorting sheds of the mills to the wharves at the company's yard, where it is distributed in the original units by the company's own bay and river craft

accommodate a given number of lumber units to the extent of 2,000,000 feet, board measure, allowing 80 percent efficiency of stowage below decks and 84 percent on deck. Liquid fuel is used on the vessel, as is customary on all of the steamers in this particular trade; but contrary to the usual custom of storing the fuel in the double bottom, where the loose liquid has

FIG. 2.—DECK OF ADELINE SMITH, SHOWING UNITS OF LUMBER OF CONSTANT WIDTHS, BUT OF VARYING LENGTHS AND SIZES

to the various yards and landings of the purchasers. All of the seagoing steamers are discharged at one wharf and proceed to sea immediately. The lumber units are 4 feet by 4 feet square, made up in varying lengths and up to 8 tons weight. The units are lowered into their places in the holds of the vessels and on deck by the electric travelers, and require no further handling after leaving the crane hook. The time, therefore, that is required to load or to discharge the *Adeline Smith* is a simple calculation of the number of trolleys available and the speed of lifting and lowering.

been found a disturbing factor in the operation of a lumber vessel carrying the usual high deck loads, especially in heavy weather with a beam sea, the *Adeline Smith* is fitted with a central fuel tank, designed to overcome the disturbing factor.

Reference to the drawings of the *Adeline Smith,* published in the August, 1912, issue of INTERNATIONAL MARINE ENGINEERING, shows that the free surface of the liquid fuel carried in the contracted thwartship tank is very small, and, therefore, practically negligible as a disturbing factor to the stability of the vessel. On the other hand, there is a tendency by

this arrangement to improve the stability on account of the fact that the center of gravity of the oil is lowered rapidly as the fuel is used from the tank. Other reasons of a practical character which contribute to the adoption of this design can be readily understood. The tank forms a substantial central bulkhead and longitudinal girder, thereby dispensing with hold pillars and compensating for the large holds necessitated by the size of the cargo units carried. Furthermore, as two of the cargo holds were to be used for deep-water ballast tanks, the fuel tank formed an excellent central bulkhead for this purpose.

Since going into service on the Pacific Coast, the *Adeline Smith* has established an excellent record for efficiency. The steamer made a fast run out from Newport News direct to Oregon, where her general cargo of railroad equipment and paper pulp machinery was delivered in a very satisfactory manner. From San Francisco to the mills in Oregon the voyage is generally against strong head winds and seas. As there is but little cargo offering for a Northern trip, a "light" ship makes very slow time against such weather. For this run, holds Nos. 3 and 4 in the *Adeline Smith* are filled nearly full with water ballast, and she proceeds steadily under the above conditions at excellent speed. The round trip between San Francisco and Coos Bay, Oregon, is made in four and one-half days, including loading and discharging. The distance one way is 410 nautical miles.

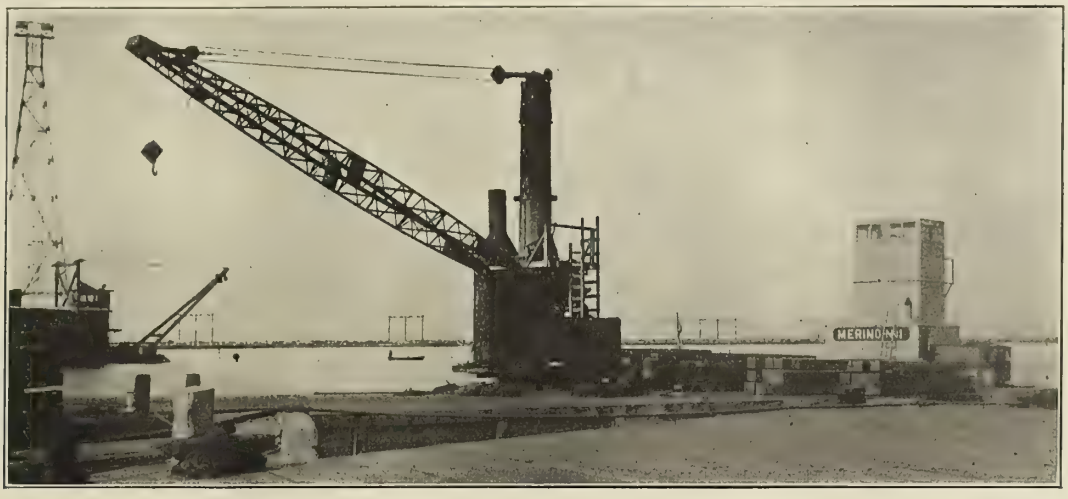

FIG. 3.—BARGE FITTED WITH STEAM REVOLVING CRANE FOR DISTRIBUTING LUMBER ABOUT THE BAY AND RIVER

In this ship it is beyond all probability that four holds can be opened to the sea simultaneously through any accident, but, should such an accident occur, the vessel would still float. The capacity of the bilge pumps is 1,100 tons per hour, the deep ballast tank pump then being capable of handling 1,000 tons per hour. In bad weather it has been noticed that against heavy seas the *Adeline Smith* is practically without the vibration which is ordinarily experienced in other vessels in the same trade not fitted with a central tank.

FIG. 4.—OVERHEAD ELECTRICALLY-DRIVEN YARD TRAVELER, WHICH UNLOADS THE VESSEL AND STORES THE LUMBER ABOUT THE YARD AS REQUIRED

The *Adeline Smith* is 310 feet 6 inches long over all, 44 feet 6 inches beam, molded, and 21 feet 6 inches molded depth, propelled by a 21, 35, 60 by 42-inch triple-expansion engine, supplied with steam by four Babcock & Wilcox watertube boilers buring oil fuel.

Single Screw Molasses Tank Steamer Amolco

The steamship *Amolco,* now under construction by the Fore River Shipbuilding Corporation, Quincy, Mass., for the Boston Molasses Co., is a single-screw steamer, with machinery aft, constructed of steel to the highest class in Lloyd's registry, being specially surveyed by that society to obtain the class 100-A-1, and designed to operate in either the molasses or bulk petroleum and general cargo and sugar trades.

The principal dimensions are as follows:

Length over all	325 feet 6 inches.
Length between perpendiculars	318 feet 6 inches.
Beam molded	46 feet 0 inches.
Depth molded to upper deck	25 feet 6 inches.
Depth molded to second deck	17 feet 6 inches.
Load draft	20 feet 0 inches.

General Arrangement

The vessel has a straight stem, semi-elliptical stern, two continuous steel decks and full poop, island bridge house amidships and topgallant forecastle. Accommodations are provided in the midship house for the officers with saloon, pantry, spare room and bath, and on the bridge deck above is the captain's suite, consisting of office and stateroom, having a wheelhouse and chart room over. The long poop encloses quarters for the engineers, oilers and petty officers, firemen and seamen, with a messroom for the officers and engineers, also bath and toilets.

The ship is rigged with two pole masts of steel, the foremast being fitted with four and the mainmast with two wooden derricks, each capable of hoisting a load of 3 tons.

The hold is divided into five double tanks, with a general cargo space forward and aft of same, the latter being separated from the former by cofferdams extending the full depth of the ship. The spaces on the second deck, at the sides and forward and aft of the expansion trunk, are also used for carrying general cargo, these and the holds being operated through large hatches fitted with wood covers and the usual tarpaulins and battening arrangements. The tanks are fitted with oil-tight hatches, and may be utilized for the transportation of molasses or bulk petroleum, a special pumping system having been installed for loading and discharging liquid cargo. A steam-heating system is also installed for liquefying cargo as well as for efficiently cleaning all spaces by steam.

The total capacity for stowing molasses is 800,000 gallons, and the capacity of the coal bunkers is about 500 tons. A double bottom is fitted under the coal bunker and machinery spaces and divided into two tanks, the one under coal bunker and boiler-room being used for reserve feed water and the one under engine-room for ballast.

The life-saving outfit consists of two 20-foot metallic lifeboats and one 16-foot working boat, all boats being stowed on the poopdeck and handled by the usual round-bar davits.

Deck Machinery

The steering gear is of the Hyde combined hand and steam screw gear type, operated through shafting and bevel gears from steering stand in pilot house.

A self-contained Hyde steam windlass is fitted on the forecastle deck, with warping ends on each side. Three Hyde steam-hoisting winches, 8¼ inches by 10 inches, double-cylinder double-drum are located on upper deck, each winch being reversible and designed for quick hoisting through double winch heads.

A quick-warping Hyde steam capstan is fitted on poopdeck aft and operated by horizontal engine on deck.

Pumping System

The pumping system for handling liquid cargo has been especially designed for pumping heavy viscous liquids, such as molasses or oil. The cargo pumps, two in number, are of the Blake horizontal duplex type, with steam cylinders, 16 inches in diameter, pump cylinders, 10 inches diameter, with 18-inch stroke. A 10-inch suction main of wrought iron extends through the cargo holds on the starboard side above the floors, with 8-inch suction branches extending into each tank, each branch being fitted with a steel gate valve and bell-mouth suction end. An 8-inch discharge main of wrought iron pipe extends through the holds above floor port side, with branches leading to each tank and to overboard discharge connections, forward and aft.

The entire system is so arranged that the cargo pumps can pump from the cargo tanks and discharge overboard from a barge direct to the cargo tanks, from any one cargo tank to any other, from the sea to any cargo tank for ballast purposes, and the tanks may also be filled through the discharge main.

Steam coils are fitted around the suction bell mouth in each hold, so that heavy oil cargo may be partially heated in order that it may run more readily to the pumps.

The forward ballast system consists of a 6-inch by 8-inch by 12-inch simplex steam pump in a pump room located in 'tween decks forward, with suction connections to sea, bilges, cofferdam and forepeak.

Electric Plant

The electric lighting plant consists of a one-kilowatt General Electric marine generating set, with switchboard and necessary wiring and fixtures.

Propelling Machinery

The propelling machinery, located in the stern of the ship, consists of a vertical inverted, three-cylinder, triple-expansion engine, with cylinders 22—37—60 inches diameter, having a stroke of 42 inches, supplied with steam at 180 pounds pressure by two single-ended Scotch boilers working under a heated forced draft system.

The bedplate of the main engine is of the usual box-section type of cast iron in three sections, having six main bearings of cast iron lined with white metal. The bearing caps are of cast iron lined with white metal. The cylinders are supported by six cast iron columns of box section, three front and three back. All crosshead guides are fitted for water circulation. The crankshaft is of the built-up type, of forged steel throughout, in three interchangeable reversible sections.

The cylinders are arranged beginning at the forward end of the engine, high pressure, intermediate pressure and low pressure. The pistons are of cast iron, box section, fitted with followers and piston rings. The high-pressure cylinder is fitted with a liner, the valve being of the piston type, the intermediate valve is of the piston type and 14 inches in diameter, and the low-pressure valve of the double-ported slide valve type. The valve gear is of the usual Stephenson double-bar link gear type.

The reversing gear consists of a direct-acting steam cylinder, 9 inches diameter and 18 inches stroke, secured to the back of the intermediate pressure back column.

A 7-inch by 5-inch single cylinder reversible turning engine is fitted at the after end of the main engine bedplate.

The thrust bearing is of the usual horseshoe type, having seven adjustable cast iron horseshoes faced with white metal. Each shoe may be adjusted separately, while the entire bearing may be moved fore and aft by means of wedges.

The propeller is of the built-up type, 15 feet 6 inches diameter, 16 feet 3 inches pitch, 72.6 square feet developed area,

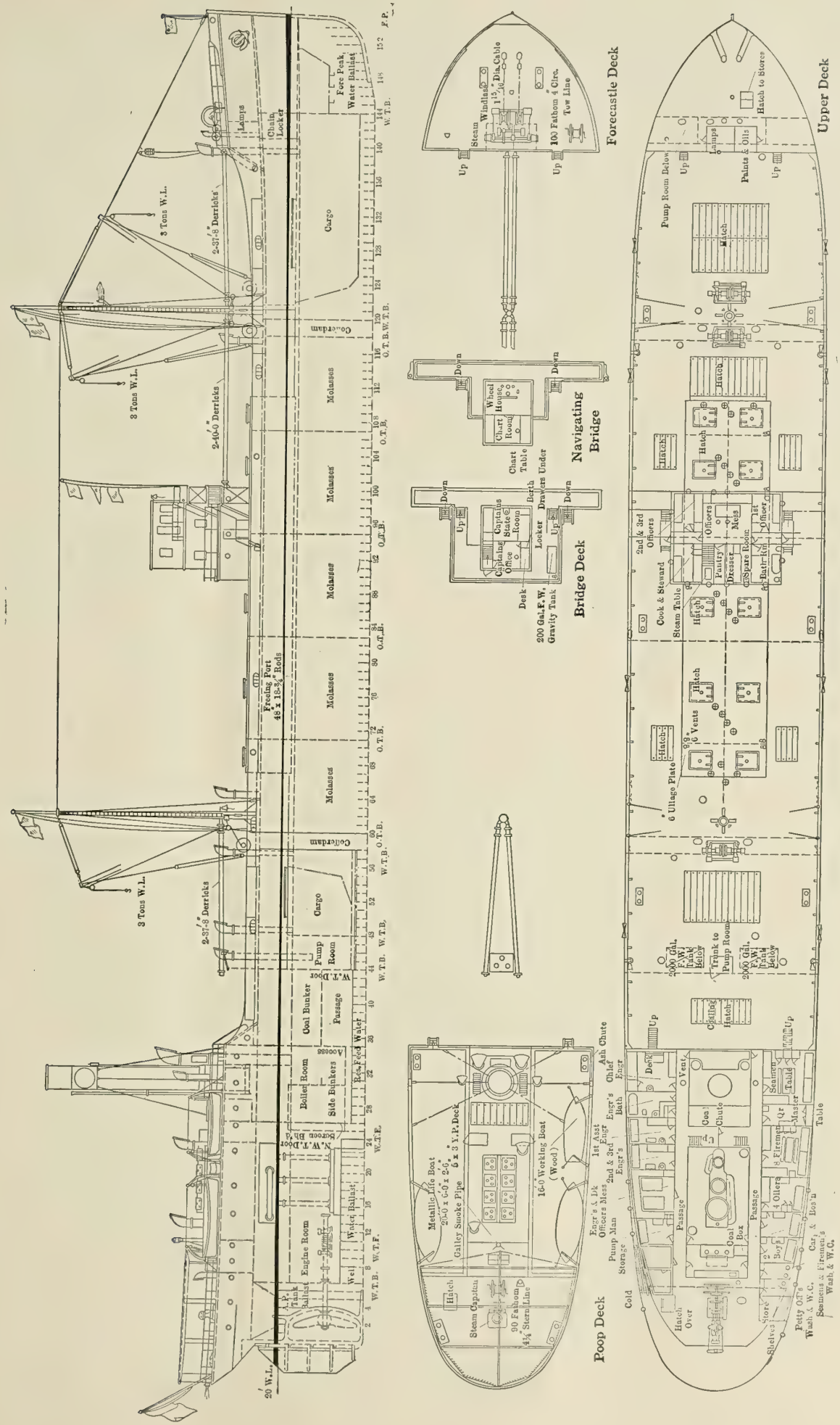

FIG. 1.—GENERAL ARRANGEMENT OF MOLASSES STEAMSHIP AMOLCO

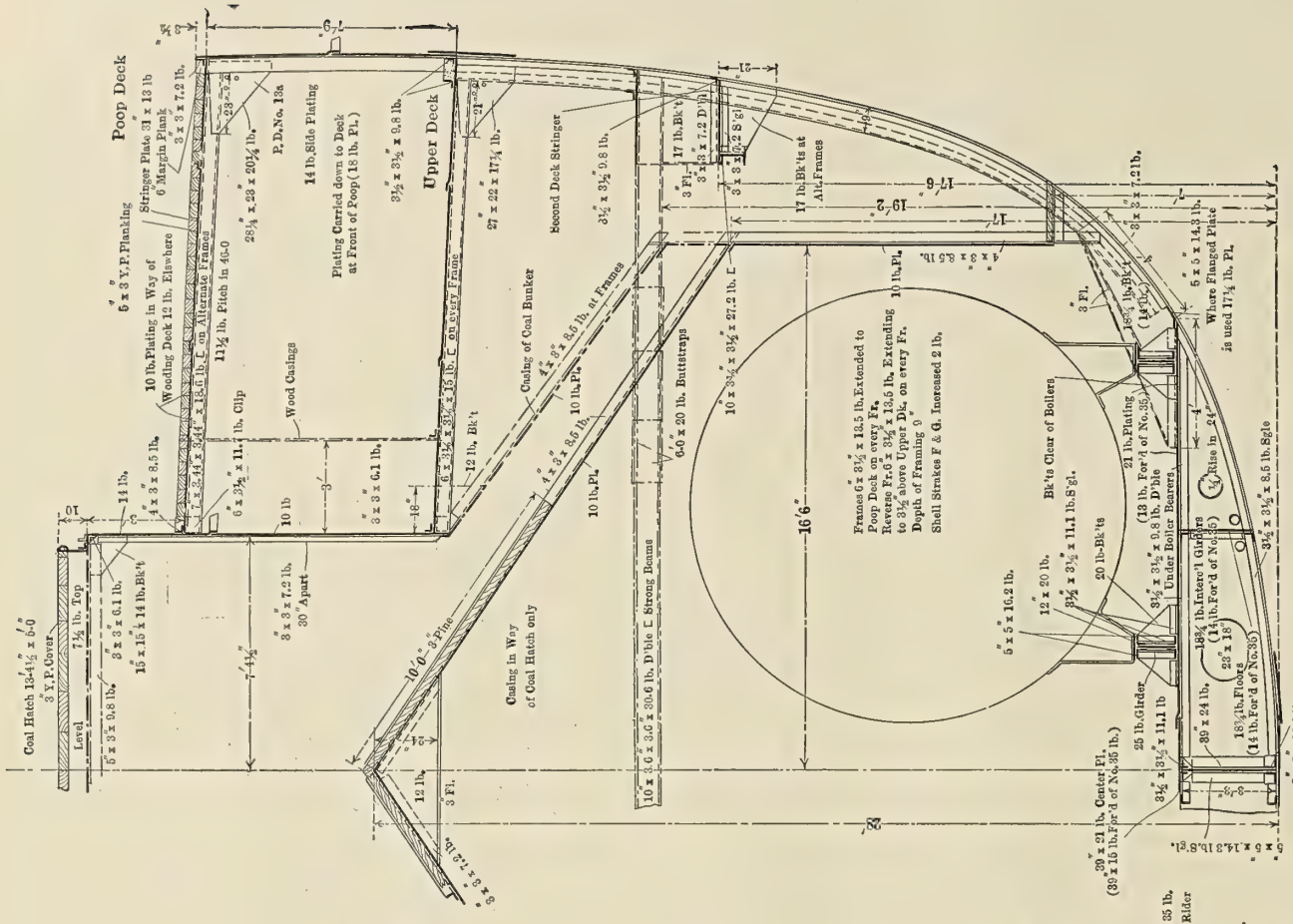
Poop Deck
Upper Deck
Second Deck Stringer
Coaling of Coal Bunker
Coal Hatch
Level
Plating Carried down to Deck at Front of Poop (18 lb. Pl.)
Wood Casings
Frames 6 x 8½ x 19.5 lb. Extended to Poop Deck on every Fr.
Reverse Fr. 6 x 3½ x 13.5 lb. Extending to 3½ above Upper Dk. on every Fr.
Depth of Framing 9"
Shell Strakes F & G. Increased 2 lb.
Bk'ts Clear of Boilers
Under Boiler Bearers
Where Flanged Plate is used
Casing in Way of Coal Hatch only
Strong Beams
Butt straps
Rise in 24"
Fig.
Inter'l Girders
Floors
Center Fl.
Girder
Plating
Bk'ts at Alt. Frames
Fl.
Bk't
Pl.
Side Plating
Wood Sheathing
Coal Hatch 13-4½ x 6-0
Y.P. Cover
Top
Bk't
Clip
Pitch
Beams
Frames
Stringer
Plating
Deck
Forecastle Deck
Upper Deck
Section A-A
Hollow Half Round
Flange-l Rad.
Every Frame to Extend to Fo'cle Deck
Frames in For'd Peak 6 x 3½ x 11.7 lb. Extending to Fo'cle Deck on every Frame
Frames 3 x 3½ x 7.2 lb. Extending Alternately to Upper & Fo'cle Deck. Depth of Framing 6"
Side Plating
Side Coamings
End Coamings
Fore & Aft Girder
Half Beams
Reverse Clip
Connection of Stanchions to Fore & Afters
Second Deck
Framing bet. Fr's No. 44 & No. 58
Framing bet. Fr's No. 120 & No. 144
Above 2nd Dk. Alter'ly Depth of Fr. 8"
Above 2nd Dk. Alter'ly Depth of Fr. 9"
Shell Strakes F & G Increased 2 lb.
Stanchions 8 Frame Spaces Apart
Elevation of Side Keelson
Keelson Pl. 21 lb. for ¼ L to 17 lb. at Ends
Base Line
Riders
Spruce Battens
Bk'ts 18¾ lbs. for 3/5 L
Floors
Spruce Floor
Bilge Bar
To Upper Turn of Bilge
In For'd Hold only (For'd of 3/5 L)

FIG. 3.—SECTION IN WAY OF BOILER SPACE

FIG. 2.—SECTION IN WAY OF FOR'D CARGO HOLD (AFTER CARGO HOLD SIMILAR EXCEPT AS SHOWN)

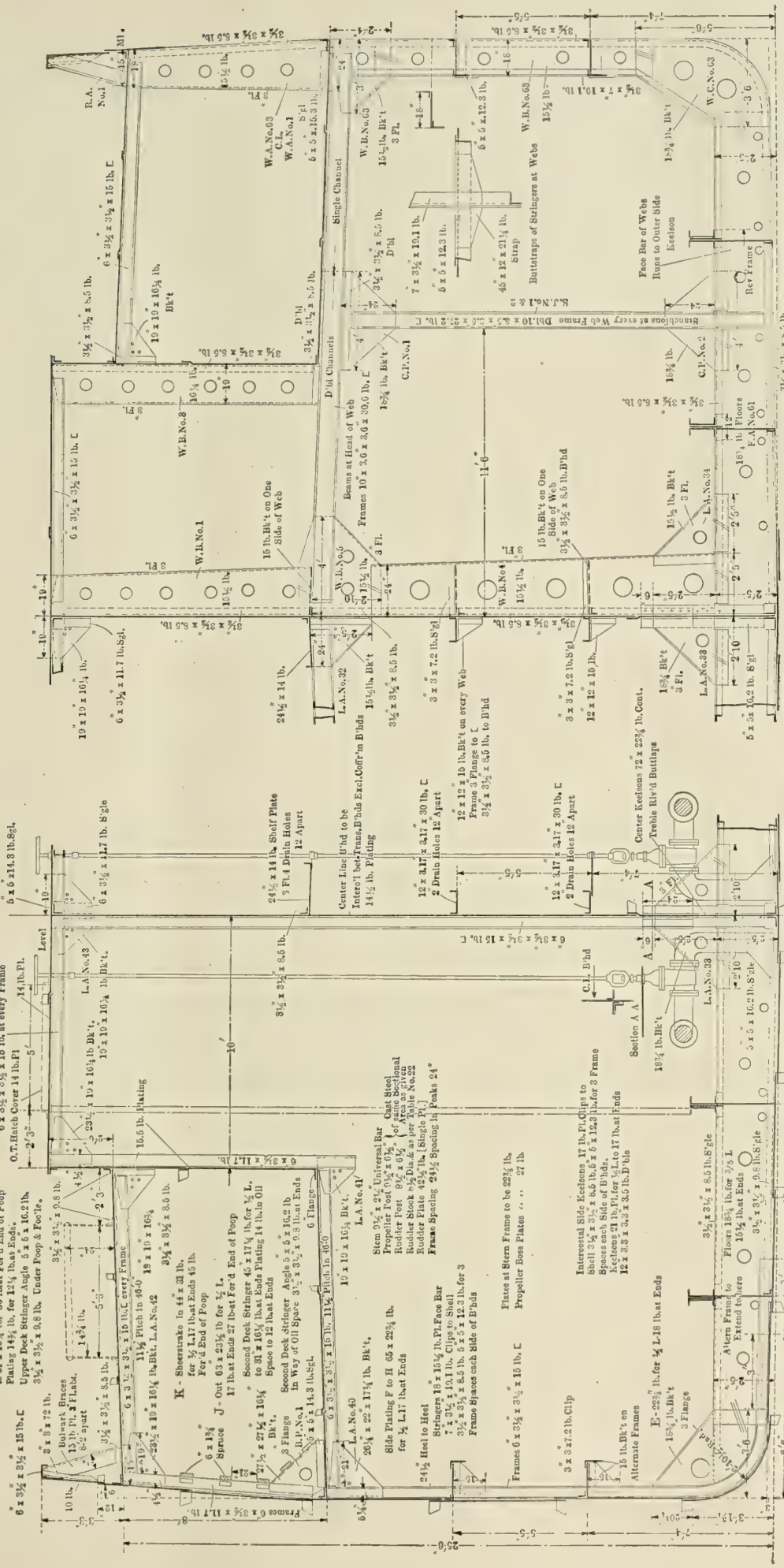

FIG. 5.—SECTION IN WAY OF WEB FRAMING IN MOLASSES TANKS, LOOKING FORWARD

FIG. 4.—SECTION IN WAY OF ORDINARY FRAMING IN MOLASSES TANKS, LOOKING AFT

having four adjustable cast steel blades secured to a cast iron hub by bronze studs and nuts.

Boilers

The boilers are 13 feet 6 inches mean diameter and 10 feet 10 inches long, arranged in a single fireroom. Each boiler has three Morison furnaces, 42 inches inside diameter, and three combustion chambers. The tubes are 2½ inches outside diameter. The total heating surface for the two boilers is 4,000 square feet, with 100 square feet of grate, giving a ratio of 40 to 1.

Air for the heated forced draft is delivered to the furnaces by a fan located in the fireroom and driven by a 6-inch by 5-inch vertical engine. On each uptake there is a heater box around which the air passes before entering the furnaces.

The vessel is fitted with one circular stack, single above the deckhouse, double below, 5 feet 6 inches outside diameter, about 70 feet high above the grates.

Auxiliaries

The air pump is of the Edwards type, 20 inches diameter, 19-inch stroke, driven by beams and links from the low-pressure crosshead.

The condenser, placed on brackets at the back of the engine, has a cooling surface of 1,800 square feet. Circulating water is taken from a centrifugal pump of the Fore River type, having 12-inch suction and discharge, the pump being driven by an 8-inch by 8-inch vertical engine.

The following additional pumps are fitted:

Two feed 3½-inch by 19-inch stroke, plunger type, attached to the low-pressure crosshead, with suctions from the sea; after tank, auxiliary condenser, feed tank and boilers, and discharge through the feed-water heater or direct to the boiler through the main or auxiliary feed line, or overboard; one auxiliary feed pump, 7½ inches by 4½ inches by 10 inches, Blake vertical duplex, 3 inches suction, 2½-inch discharge. One ballast pump, 10 inches by 12 inches by 10 inches, Blake horizontal duplex, 7-inch suction, 6-inch discharge. One salt water sanitary pump, 6 inches by 4 inches by 6 inches, Blake horizontal duplex, 3 inches suction, 3 inches discharge. One fresh water pump, plunger type, attached to main engines, 1¾ inches diameter, 8 inches stroke, 1-inch suction, 1-inch discharge. One evaporator feed pump, plunger type, attached to main engine, 1¾ inches diameter, 8 inches stroke, 1-inch suction, 1-inch discharge.

An auxiliary condenser, containing 400 square feet of cooling surface, is located in the engine-room; circulating water is taken from the ballast pump. One evaporator of the Griscom Russell type of 10 tons' capacity is located in the engine-room, steam being taken from the auxiliary steam line and vapor discharged to the condenser or feed tank.

The refrigerating plant consists of a one-ton ammonia direct-expansion type outfit, motor driven. One ash hoist engine of the Hyde make, 4½ inches by 4½ inches double cylinder, is located in the fireroom.

The Steamship Westerdyk

The *Westerdyk,* which recently underwent her official trials, is the second of two very fine vessels built by Messrs. Irvines' Shipbuilding & Dry Docks Company, Ltd., for the Holland-America Line, of Rotterdam. The dimensions are 470 feet by 55 feet by 41 feet 7½ inches depth, molded, to the shelter deck, and complete main, upper and shelter decks are fitted with a tier of strong beams at the lower deck height, and steel grain divisions all fore and aft. She is built to Lloyd's highest class, having bulb angle frames and a cellular double bottom all fore and aft for water ballast, together with a deep tank at each end of the engine and boiler space.

The vessel is fitted with four masts of sufficient length for the carrying of the aerial wires in connection with a Marconi installation, and a most complete and up-to-date arrangement of loading and discharging gear is provided, consisting of twenty 7-inch by 12-inch silent-running steam winches, together with eight derrick posts and thirty-two Mannesmann steel derricks; in addition to this a 40-ton steel derrick is fitted so as to deal with heavy lifts in either No. 1 or No. 2 hold, a special worm gear winch being provided for working this derrick.

A special feature of this vessel is that the whole of the accommodation, including the sailors' and firemen's, is placed in a large steel house on the shelter deck amidships, having a promenade deck over same 150 feet in length. The sailors and firemen are berthed in separate compartments, with large messroom, wash places, lavatories, etc., for each department. Accommodation generally for the captain, officers and engineers is fitted in spacious rooms, special attention having been paid to light and ventilation; steam heating is also fitted throughout the whole of the accommodation. A special Marconi room is situated on the shelter deck amidships, complete with silent chamber, etc., and a long-distance wireless telegraphy installation has been fitted by the Marconi Company.

The machinery, which has been constructed by Messrs. Richardsons, Westgarth & Company, Ltd., Hartlepool, consists of a powerful set of balanced quadruple-expansion engines, with six large boilers working under natural draft at a pressure of 215 pounds per square inch. The cylinders are 27½ inches, 37¾ inches, 55 inches and 84 inches diameter by 60 inches stroke, each being independent, with receiver pipes of steel and universal expansion glands. The high-pressure cylinder is fitted with a piston valve, the two intermediate cylinders with flat balanced valves and the low-pressure with a double-ported slide valve, the ports and passages being in accordance with the engine builders' latest practice. Each of the cylinders is supported by two heavy cast iron columns, which are braced together at the top with strong box girders, these also forming supports for the reversing gear. The shafting throughout is of fluid compressed steel, the crankshaft being in four interchangeable parts with webs of special form as required for the system of balancing; the large four-bladed propeller is made entirely of bronze.

The condensing and feed heating installation is very complete, and embraces the entire contraflo system, as adopted when independent feed pumps are fitted in addition to the feed pumps on the main engines. The system comprises contraflo main and auxiliary condensers, direct-contact oil separating feed heater, Cascade water filter and thermal receiver and drainage separator, the independent feed pumps being of the Mumford "Dreadnought" type. An excellent arrangement has been effected in the engine room of the large number of auxiliaries; these, in addition to those forming part of the contraflo system, include Drysdale centrifugal pump, Mumford auxiliary feed pump float controlled from Cascade filter, Mumford's ballast and general service pumps, and combined air and circulating pumps for the auxiliary condenser, also a Morison's surface feed heater and a large evaporator of the vertical radial type.

Award of Howard N. Potts' Gold Medal.—Professor Wm. A. Bone, D. Sc., Ph. D., F. R. S., Professor of Chemical Technology of the Imperial College of Science and Technology, inventor of the Bonecourt system of flameless incandescent surface combustion, and technical adviser to Bonecourt Surface Combustion, Ltd., has been awarded by the Franklin Institute of Philadelphia its "Howard N. Potts' Gold Medal for distinguished work in Science or the Mechanic Arts," in recognition of his work on "Surface Combustion," upon which subject he gave a lecture before the institute on October 30, 1911.

First Dutch Shipping Exhibition

BY F. MULLER VAN BRAKEL

The first Dutch shipping exhibition was opened June 4 at Amsterdam. The exhibition grounds are located where the visitors are afforded a splendid view of the picturesque city of Amsterdam and of the shipping activities of its famous harbor. The building devoted to Amsterdam, which contains pictures and models showing the advance of commerce, and the building housing the historical section of the exhibition, are situated in a beautiful garden, while the main buildings, including the British section and the places of entertainment, are situated behind the garden.

As it would be impossible to describe or even mention, in the limited space available for this article, all of the separate exhibits, only those of most importance and deserving special mention are recorded in the following:

The Nederlandsche Scheepsbouw Maatschappij, of Amsterdam, has a large exhibit, with fine models, of its latest ships, including the India liner, *Koningin der Nederlander,* of 8,200 tons and 15 knots; the Belgian Diesel motor-tank ship, *Emanuel Nobel;* and the well-known *Vulcanus.* A half model is also exhibited of the *Emanuel Nobel,* showing the internal arrangement of the big oil tanker, with its bulkheads and cofferdams, piping arrangement and the two Werkspoor Diesel engines of 1,100 brake horsepower each.

In the exhibit of the Maatschappij voor Scheeps-en Werktingbouw Fijenoord, Rotterdam, is a model of the first marine compound engine, which was built in its shops. Models of the cylinders of marine engines in this exhibit show a very ingenious arrangement of flat high-pressure valves, with a relief hood between the high-pressure and intermediate-pressure cylinders, leaving the working face of the valve quite accessible and open for inspection and regrinding, and, at the same time, shortening the length of the engine some 4 feet.

A model of the latest 30-knot destroyer, built for the Dutch navy, is exhibited by Kononklijke Maatschappij de Schelde, Flushing. Werf Gusto, of Schiedam, exhibits the model of a 150-ton floating crane built for the Italian navy, and an interesting model of a gold dredger is exhibited by Werf Conrad, Haarlem.

The Koninklijke Paketvaart Maatschappij, whose fleet of 85 modern steamers connects the islands of the Dutch East India archipelago with Australia, is represented by a large plastic map showing the routes and steamers of the company.

On a small stand, by means of a couple of models, is shown a novel method of arranging lifeboats on liners, by which three boats may be stowed on the outer edge of the boat deck, where commonly only one boat can be placed. This is accomplished by attaching each boat under one stout Welin davit, both being placed in a vertical position. The bow of the boat then points upwards, the sternpost extending transversely parallel to the deck. By swinging over the davit, the boat is brought into a horizontal position, with the bow away from the ship, and it may then be lowered in the ordinary way. On reaching the water the boat is well clear of the vessel and in no danger of being crushed against it. Patents have been taken out for this arrangement by the inventor, Mr. Lagaay, an officer of the Holland-America Line.

Among the models of British-built Dutch ships, two may be mentioned:

The *Gelria,* of 14,500 tons gross and 11,500 indicated horsepower, building at Messrs. Alex. Stephen & Sons to the order of the Hollandsche Lloyd (Amsterdam-Buenos Ayres), and the *Nestor,* of the Dutch Blue Funnel Line. The latter is one of the very few models of cargo boats, and is equipped with 22 cargo winches, 4 masts and many derrick posts, showing a most up-to-date loading and discharging arrangement, which will attract the attention of masters, stevedores and shipowners.

The same class of people will be attracted by another stand, outside the main building, where the newest type of Sieurin's cargo winch may be seen handling cargo. The usual modern loading or discharging gear consists of two steam winches in combination with two derricks. The load is raised by one winch, then swung to the side by the other and lowered by the two winches paying out at the same time. The Sieurin winch, on the other hand, is fitted with two independent drums worked by the same set of cylinders, and it is thus possible to perform all necessary operations by means of one Sieurin winch. Besides the usual stop valve, reversing lever and foot brake, the Sieurin winch has only one extra lever and can be worked by one man, without special training.

A part of the main exhibition is devoted to statistical and other information concerning the Dutch merchant fleet, the different types of sailing vessels, the location of shipyards in Holland, etc. On a large table (70 feet by 17 feet), representing the North Sea, are placed some five hundred models (built on a scale of 1:500), representing the complete fleet of Dutch steamers.

Though the exhibition is a national one, there is a British section, where most of the best-known British shipbuilders and marine engineers have fine exhibits. Among these may be mentioned: Armstrong, Whitworth & Company, Ltd., with splendid models of warships, including the Brazilian dreadnought *Rio de Janeiro;* Vickers Sons, exhibiting ships and guns; John Brown & Company, Ltd., with models of the *Hindustan, Asaki, Inflexible* and others; Hingley & Sons, with cable links; Welin Davit Company, Ltd.; Parsons Marine Steam Turbine Company, Ltd.; and William Hamilton & Company, Ltd., exhibiting models of well-known Dutch freighters.

This section gives a splendid opportunity to study the development of British-built dreadnoughts, and it is interesting to note that again the lead is given to foreign-owned Elswick ships. It is to be regretted that no catalogue of the British section has appeared.

Illumination of Docks and Wharves

The vast sums of money invested in modern vessels make it imperative that every facility be provided for their speedy loading and unloading, as the earning power of a vessel is naturally suspended while it is docked.

For years inventors have worked on machines and methods of speedily accomplishing this end, and with wonderful results, but it is only within a comparatively short time that there has been a realization of the importance of proper illumination in this connection.

The same conditon also obtained in industrial plants until recently, when illuminating and efficiency engineers compiled statistics that showed startling results. For instance, it was shown that a substitution of proper lighting for poor lighting increased the efficiency of the workmen in some plants 10 percent; and a few isolated cases were found where the efficiency, or output, during the time artificial light was used, was increased as much as 25 percent. Furthermore, it was proven conclusively that the number of avoidable accidents was in direct proportion to diminishing light; and it is claimed by authorities who have made a study of safeguards for the benefit of employees that 25 percent of the avoidable accidents were caused by poor illumination.

That which holds true regarding the increased efficiency resulting from the proper lighting of industrial plants also holds good for docks and piers, and possibly to a greater extent. The proper illumination of docks and piers not only materially increases the efficiency of the workmen by enabling them to read the markings on freight with facility, lighting their way distinctly, etc., but it greatly decreases the liability to accidents. This is a very important item, as the nature of the work which stevedores and freight handlers do is very hazardous.

FIG. 1.—ILLUMINATION OF QUEBEC STEAMSHIP COMPANY'S PIER, NORTH RIVER, NEW YORK

When the dock is a passenger terminal, proper lighting is of extreme importance from another point of view, as it has an important psychological bearing on the impression given the arriving or departing passenger regarding the service of the line; in other words, plenty of light tends towards cheerfulness. That this feature is important is demonstrated by the modern tendency of railroads to illuminate brilliantly their waiting rooms.

FIG. 2.—EXTERIOR OF TYPE W LAMP

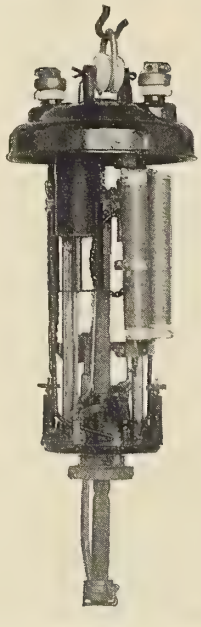

FIG. 3.—MECHANISM OF LAMP

A recent example of good pier illumination is at the Quebec Steamship Company's pier, North River, New York City. This pier is 400 feet long by 60 feet wide, and is so arranged that boats may be unloaded from either side. Four Type-W long-life multiple flame arc lamps, manufactured by the General Electric Company, have been installed. These lamps are located along the longitudinal center of the building, and are approximately 24 feet above the floor. As soon as it becomes dark the two end lights are turned on and are kept burning all night. When shipments, however, are being unloaded the remaining two lamps are also lighted.

The Type W lamps are especially adapted for this class of lighting, because they are an exceptionally high candlepower unit, and the brilliancy remains undiminished throughout the carbon life. They are very economical to operate, as they burn from 100 to 120 hours without attention, and even then it is necessary to renew only one electrode. The mechanism is extremely simple, and the parts are especially treated so that dampness and salt air can have no effect.

STEEL TUG SENATOR BAILEY.—John H. Dialogue & Son, Camden, N. J., has recently completed for the Steele Towing & Wrecking Company, Galveston and Texas City, Texas, the steel tug *Senator Bailey,* 125 feet long, 26 feet 6 inches beam, 14 feet depth of hold, designed by T. J. Anderson. Propulsion is by compound engines, supplied with steam at a pressure of 150 pounds per square inch by a Scotch marine boiler, fitted with oil fuel burners of the Dahl type. The fuel tanks have a capacity of 56,000 gallons, which will enable the tug to steam for about twenty days without replenishing her fuel supply. The auxiliaries include a 10 horsepower donkey boiler, feed water heaters and filters, and a 7½ kilowatt dynamo which supplies current for lighting and for a powerful wireless equipment. The tug is thoroughly fitted out for towing, salvage, wrecking and fire-fighting purposes.

THE SPOKANE, PORTLAND & SEATTLE RAILWAY COMPANY'S NEW STEAMSHIPS.—The two passenger steamships building at William Cramp & Sons' Ship & Engine Building Company, Philadelphia, for the Spokane, Portland & Seattle Railway Company, are 500 feet long, 63 feet beam, 34 feet 6 inches molded depth. They are to be propelled by Parsons turbines at a normal speed of 22 knots and will be used in Pacific coastwise trade, although terminals have not been announced.

Ship Construction Treated from a Structural Engineering Standpoint

BY JAMES E. STEELE, B. Sc., A.M.I.N.A.

The material of which a vessel is composed does not appear, as a general rule, to be disposed in such a manner that the strength at any point of the vessel's structure is proportional in all cases to the stress at that point. Were the question of the strength of the vessel treated just as minutely and with as careful a regard to the relation of the strength of the member to the stress it is called upon to bear, as in a structural engineering problem, a better result would in all probability be obtained for the same weight of material. A saving of weight in one part would mean material in hand which could be used freely in strengthening parts which are greatly stressed, due to local weights, discontinuities in structural strength, etc.

If it is agreed that the general run of vessels are sufficiently strong at all points, then the following may indicate where weight could be saved without, of course, sacrificing strength. Before altering the arrangement of material, however, either for a better result as regards strength, or as a means of weight saving and consequent reduction in cost of material and increase in earning capacity, we must consider the increased cost, if any, of workmanship and maintenance.

The object of this article is to urge the engineering method of treating each structure, or vessel, as a new problem, and each item on its own merits. It is thought that the best way of illustrating the treatment suggested is by treating one portion of the vessel, and a choice has been made of the cellular double bottom, with a view to obtaining a structure of adequate strength, and yet effecting a saving in weight over present-day practice.

The problem, a solution of which is sought here, is to get a bridgelike structure which will carry the uniform load due to cargo, etc. What follows refers to a transversely built vessel; to read it into the longitudinal system, the simple interchange of the terms "floor" and "longitudinal" is alone required.

Load on Floor

The load is composed of a uniformly distributed load, due to weight of cargo, weight of structure, etc., and concentrated loads due to pillars, the heads of which are loaded, and to the longitudinals. Two extreme cases of maximum loading are taken below:

Case I. Uniformly Distributed Load; Double Bottom empty.—The weight of the cargo is such as will sink the vessel to the load-line. To arrive at the proportion which the floor bears of the total cargo load per floor space, we proceed as follows: The plate, if loaded to destruction, fails by cracking along the dotted lines (Fig. 1), approximately, so that we take the load on the hexagon *A* as being borne by the floor, and that on the square *B* as being borne by the longitudinals.

The weight of the structure comprises the floor, the portions such as *A* (Fig. 1) of the inner bottom and shell, which though not uniformly distributed along the floor, may be taken as being so.

Uniformly distributed load = weight of cargo + weight of structure — vertical component of water pressure over parts such as *A*, Fig. 1.

These are distributed as under:

Top Boom, or top member:

Uniformly distributed load = weight of cargo + ½ weight of floor + weight of inner bottom.

Bottom Boom, or bottom member:

Uniformly distributed load = ½ weight of floor + weight of shell — buoyancy.

Case II. Uniformly Distributed Load; Double Bottom full and pressed.—The weight of the cargo (*W*), assumed to be wood carried in holds and on deck, is such that, when added to the weight of the water (*w*) in the tanks—required for stability—it sinks the vessel to the load-line:

Uniformly distributed load = weight of cargo + weight of structure + weight of water in tank — vertical component of water pressure.

The pressing of the double bottom does not enter into the equation, as the double bottom is a self-contained system, and any forces set up within that system cannot affect the external forces acting. It is a different matter, however, when we consider the load applied to each boom, which is important, from the point of view of the stresses in the web.

These are distributed as follows:

Top Boom:

Uniformly distributed load = weight of cargo *W*—*w* + ½ weight of floor + weight of inner bottom — pressure of water in tank.

Bottom Boom:

Uniformly distributed load = weight of water in tank, *w* + ½ weight of floor + weight of shell + pressure of water in tank — buoyancy.

It will be seen that the uniform load on the upper boom is less, and that on the lower boom is more in *Case II.* than in

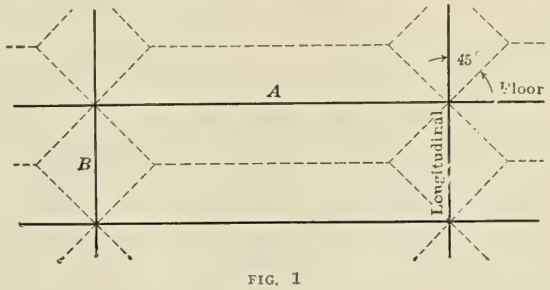

FIG. 1

Case I. Both cases must, therefore, be worked out, and each member designed to meet the greater of the two stresses obtained.

Another case which may have to be treated is that of the vessel in ballast. In this case the uniformly distributed load on the top boom is half the weight of the floor, plus the weight of the inner bottom, and minus the pressure of water in the tank. The uniformly distributed load on the bottom boom is the weight of water in the double bottom, plus half the weight of the floor, plus the weight of the shell, plus the pressure of the water in the tank, and minus the upward pressure due to buoyancy. In this case the lower boom is in compression and the upper in tension.

The relative importance of these three cases cannot be discussed generally, but with figures at hand for the weights mentioned in the three cases a few minutes will show which cases are extreme and therefore worthy of consideration.

Concentrated Loads

Some of the loads are applied by the pillars, and in as many places as there are rows of pillars. The beam which the pillars support is in the position of a beam with built-in ends, supported by one or more pillars, and loaded with a uniform load, due to the weight of the beam, deck and deck cargo, if any. Local weights, such as winches, etc., may also have to be borne.

The remaining concentrated loads are those applied by the longitudinals.

Support to the Floors

The sides of the vessel offer the support to the ends of the floor. In reality, the sides sling the bottom under nearly all conditions, and this has the same effect as the support offered by abutments to a beam.

The strength required, from this point of view, for connec-

tion to the frame outside the tank, is sufficient shearing strength to prevent the bottom from tearing out the vessel, or, in the case of a "light" vessel, of being forced into her. In addition, however, the strength of this connection must be sufficient to "fix" the end of the frame so that it may act as a beam built in at the ends. The connection outside the tank is much greater, for the latter reason, than is required to withstand the shear mentioned above, so that we do not need to further consider the strength against shear. We will treat the floor as being simply supported at its ends.

Type of Floor

A form of floor equivalent to the open-web type of bridge girder is adopted in preference to the plate-web type for several reasons.

The braced girder is more economical of material than the plate-web girder, as we can grade the strength of the former so as to get a girder of uniform strength, *i. e.*, one whose strength at any point is proportional to the stress at that point.

Drawing the shearing force and bending moment diagrams for a beam uniformly loaded, and simply supported at its ends (Fig. 2), we see that the shearing force is greatest at the ends

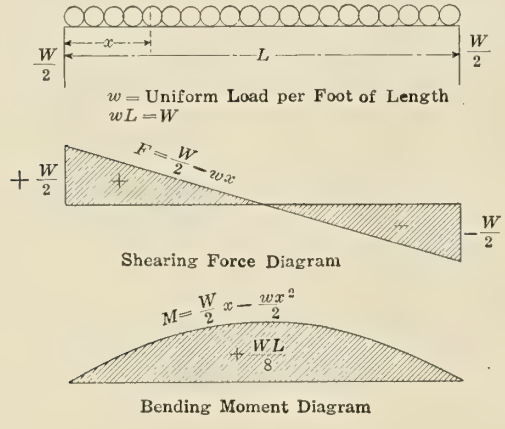

FIG. 2

and least at the middle, and that the converse holds for the bending moment. The addition of concentrated loads would not alter these characteristics, though it would affect the values of the shearing force and bending moment at different points along the length of the beam.

The above shows the variation in stress along the length of the floor, and as the booms take the whole of the bending moment, and the web the whole or the greater part of the shear, we see that there is no call for uniform strength throughout the length of the girder, which we get, practically, in the floor as usually fitted.

In a plate-web floor, we could grade the booms to meet the varying bending moment, but the web must be thick enough to meet the greatest stress, so that material is wasted throughout a great part of its length. This grading of web strength is very easily accomplished in a braced girder.

In the floor as fitted, it may be urged that the angles for attaching it to the longitudinals stiffen it against buckling, but if the plate be economically thin, any angle stiffening should be spaced more closely together as the ends of the floor are approached. Again, these stiffeners are not at an efficient angle, the efficient angle being 45 degrees towards the supports, as can be seen from the following:

Shear in a vertical plane is accompanied by a shear stress of equal intensity in a horizontal plane (Fig. 3). These produce two direct stresses of equal intensity, as shown, also at right angles to one another, but inclined at 45 degrees to the shear stresses. The plate will tend to buckle under the action of the compressive stress, although the buckling is prevented to an extent by the tension at right angles to it tending to hold the metal in its true plane. The stiffener fitted to prevent this buckling—the only way in which the plate is likely to fail—should, therefore, incline towards the support at an angle of 45 degrees.

In adopting the braced floor, we have the satisfaction of knowing that the very best has been got out of the material used, and that no material is thrown away in places where it is worse than useless.

The actual saving in weight of the open-web floor over the plate-web floor is a cumulative one, as a saving of weight in any member means a lighter structure, and this, again, results in a saving of weight in every other member, as a smaller structural weight has to be carried. Even a small saving of weight in each floor is worth while, as when multiplied by the number of floors where the reduction can be made the saving is appreciable.

The open web gives ready access to all parts of the double bottom without sacrifice of strength. The same cannot be said for the manholes which are cut out of the plate web just where its strength is most required, *i. e.*, where the shear is greatest, the curve of shear stress in the direction of the depth of the floor being parabolic.

Another advantage in the open-web floor is that, for the same span, an increase in the depth of the floor means a saving in weight. As the stresses, and, consequently, the cross-sectional areas of the booms, vary inversely as the depth of the floor, an increase in the depth will mean a saving in boom

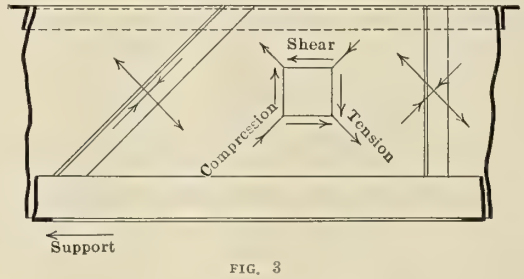

FIG. 3

weight, which more than compensates for the additional weight of the diagonal members, which are longer than before, though their scantlings remain the same, the shearing force being unaltered.

In an open-web floor, moreover, there is a saving over the plate-web floor of surface of metal exposed to corrosion.

For docking, a strong longitudinal fitted in the middle line would support that portion of the weight of decks, etc., which is taken by the pillars, that is, supposing a central row of pillars. The rest of the weight of the vessel (the double bottom excepted) is supported by the floor acting as a double cantilever, the forces at the bilges zigzagging through the bracing to the blocks. When quarter pillars are fitted, the bending moment on the double cantilever is greater than with the central row of pillars. If there is any doubt as to the capabilities of the open-web floor for supporting the vessel when docking, a reciprocal diagram can easily be run out for the central support, and the stresses determined.

Exception may be taken to the fact that there is not a sufficient margin of strength in the open-web floor against grounding, if such were to happen; but there is no reason why an open-web floor should not resist such crushing equally as well as a plate-web floor. It might be argued that even if the open web adopted were to crush on the vessel taking the ground, it would be preferable to the floor resisting buckling, but starting the rivets in the inner bottom plating. In any case, the proposed open-web system, when fitted on every frame, will give as much support to the shell as the solid floor fitted on every

second frame, alternating with a very meagerly supported frame and reverse.

Arrangement of Bracing

The simplest form of bracing we can adopt is one which will result in a floor built up of triangles, and therefore rigid. In this type, when we assume pin-joints, the members are subjected to pure push and pull, and the values of the stresses can be exactly determined by means of the reciprocal diagram, or by the method of sections. It will, however, probably be found that a more complicated form of bracing is desirable, so as to better distribute the boom support, also to provide for unequal loading of the floor. The fewer the systems we combine to form the floor the better the size of the diagonal members would be reduced in all cases as we approach the center where the shearing force is least; but when the member is small to start with, the practical minimum of size (mainly fixed by corrosion considerations) is reached before we attain the least stressed diagonal. In this way diagonals have to be fitted which are uneconomical, being heavier than the stresses require.

The form shown (Fig. 4) has many advantages. It is composed of two simple systems superposed. In arranging the bracing, it should be borne in mind that 45 degrees is the most efficient inclination of the diagonal members. Floors thus composed of a double triangulation are in reality statically indeterminate, but may, without material error, be treated by the reciprocal diagram method.

In all cases the floor is supposed to be pin-jointed, *i. e.*, joints which cannot transmit a bending moment. The uniform load is transmitted to the joints by the members of the booms—supposed pin-jointed where they meet the bracing. It is these joint loads which act upon the structure as a whole.

It is usual to neglect the additional bending stresses set up in the members whose ends are riveted, due to their bending slightly on the structure being deformed.

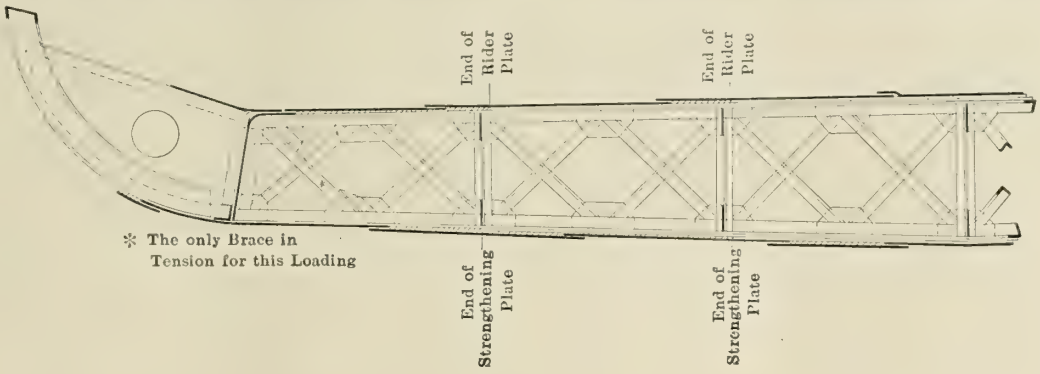
End of Rider Plate
End of Rider Plate
* The only Brace in Tension for this Loading
End of Strengthening Plate
End of Strengthening Plate

FIG. 4

Alternative Methods of Finding the Stresses in the Members

The stresses in the various diagonal and vertical members, also in the portions into which the booms are divided, may be determined by whichever of the following methods is thought advisable:

1. The braced floor is divided up into two "perfect" floors, composed of triangles, and, consequently rigid (Figs. 5 and 6); then each of these floors is treated separately by means of a

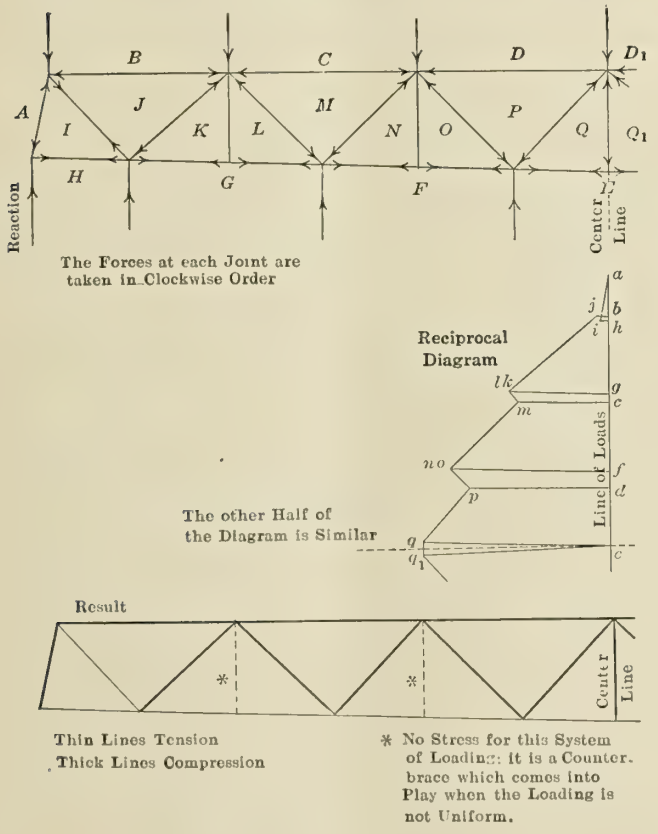
Reaction
Center Line
The Forces at each Joint are taken in Clockwise Order
Reciprocal Diagram
Line of Loads
The other Half of the Diagram is Similar
Result
Center Line
Thin Lines Tension
Thick Lines Compression
* No Stress for this System of Loading: it is a Counter-brace which comes into Play when the Loading is not Uniform.

FIG. 5

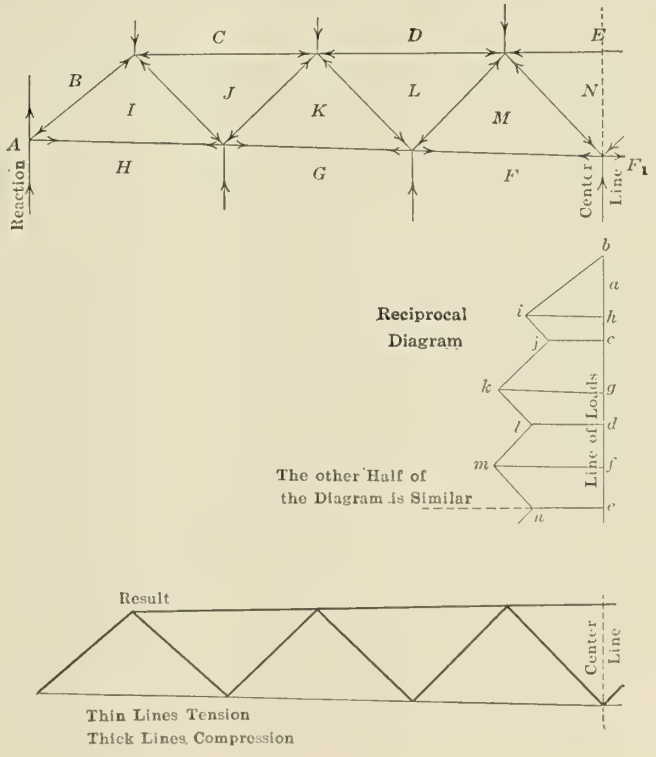

FIG. 6

reciprocal diagram, the booms being included in each case. In each component floor those loads are included which act at the apices of the triangles composing the floor, and so pass along the diagonal members to the supports. The resulting stresses give directly the stresses in the inclined and vertical members which enter only once into the component floors, but the two results for the boom stresses must be added to give the total boom stress at any point.

2. The floor is treated as it stands by means of the reciprocal diagram (Fig. 7), on the assumption that the crossing points of the inclined members, and where they are riveted together, are pin-joints. This gives the stress twice over for

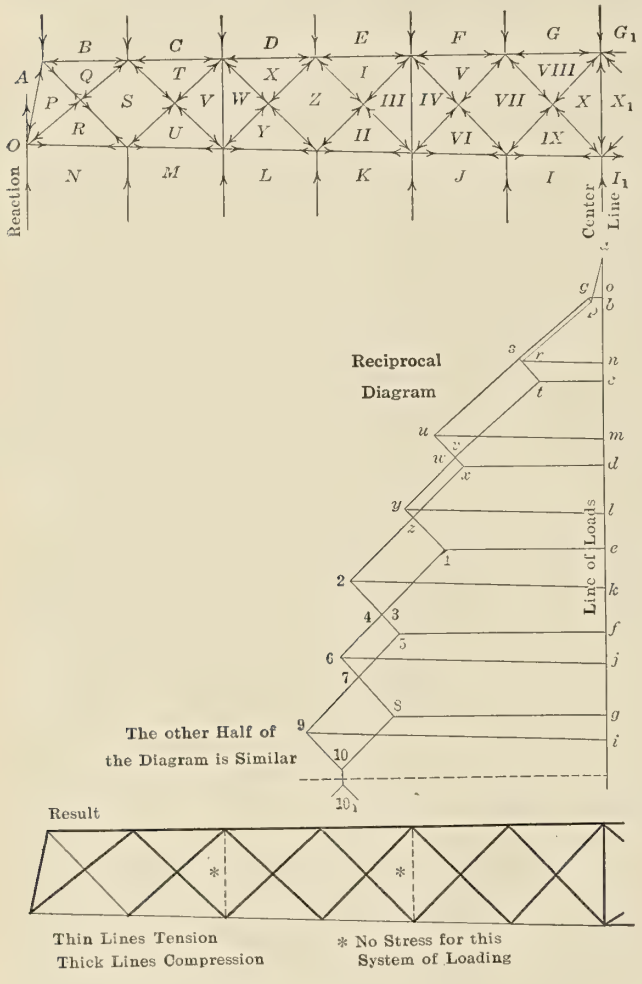

FIG. 7

the same inclined member, which stresses are not, however, additive, but confirm one another.

3. The stresses are got by the method of sections applied to each of the component floors of the first method.

The method of sections is specially convenient when the depth of the floor is uniform (vessels with very small rise of floor); but one or other of the reciprocal diagram methods is, for several reasons, to be preferred for floors of varying depth (vessels of appreciable rise of floor). The method of sections is valuable as a check for the stresses found by the reciprocal diagram, and may for this purpose be applied at several sections of the floor.

Boom Stress

When finding the boom stresses from the reciprocal diagram, we take the boom as being composed of a number of members stretching between each pair of (assumed) pin-joints where the diagonal or vertical members meet the boom. In this way we get the stress in the boom to vary in steps along its length.

We can also get the boom stress at any point from its bending moment diagram, which diagram is of great use, as it gives a graphical representation of how the strength of the boom must vary if it is to be of uniform strength along its length, that is, if its strength at any section is to be proportional to the bending moment there. To meet the requirements of increasing bending moment towards the center, the floor must, if economy of material be desired, be either of varying depth, called a "parabolic girder" from the form it takes, or of constant depth but varying thickness of boom, called a "parallel girder." The floor of a vessel with a considerable rise of floor is more of the parabolic than the parallel type, and allowance must be made for this when fixing the strength of the boom at intervals along its length, with a view to getting the same strength throughout the length of the floor.

The variation in boom strength can be got by one or more rider plates for the top boom, and one or more strengthening plates for the bottom boom (Fig. 8), the several rider and strengthening plates terminating at different points so as to

FIG. 8

grade the strength. In this way the booms could be lighter, even with the weight of the rider and strengthening plates added, than those whose section throughout is that required to meet the maximum bending moment. The thickening up of shell and inner bottom at center line assists this grading of strength.

As the strength at any point of the boom has to be proportional to the bending moment at that point, the bending moment diagram is the stress diagram for the booms, when read to the proper scale for the latter. The bending moment diagram must first be drawn for the uniform load, then to it we add the bending moment diagram for each concentrated load. To get the stopping points of the rider and strengthening plates, we divide up the bending moment diagram into strips equal in number to the plates we wish to add (Fig. 9). Projecting up the points where these strips cut the bending moment diagram,

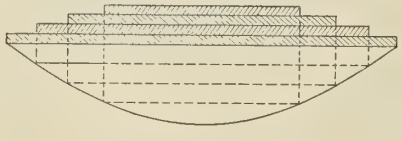

FIG. 9

we get the stopping points of the plates. The plates should overlap these points by about six inches (overlap not shown on figure).

Web Stress

The web in the case of the parallel floor takes all the shear, as the boom stress has no vertical component.

When the lower boom is inclined, as in the floor of a vessel where we have an appreciable rise of floor, the boom takes part of the shear, as the stress in this boom at any point has a vertical component which, when added to the vertical component of the stress in the bracing, must equal the shear at that point.

Weight of Floor

We can first neglect the weight of the structure and get the stresses due to cargo, pillars, water pressure, etc. The members can then be roughly designed to meet these stresses, and the weight of the structure calculated. The reciprocal diagram is subsequently modified to suit this weight. This is a lengthy

process, but if each time that the weight of the floor is computed the weight per foot run is plotted on a base of total load on floor (exclusive of its own weight), sufficient spots will in a short time be obtained for running a curve which can be used to get the dead load on the floor, due to its weight alone. An empirical formula might be arrived at from the curve, giving the weight of floor per foot run in terms of the external load.

Practical Details

In arranging the practical details of construction, care must be taken that secondary stresses are not set up. These secondary stresses are those of bending, due to the following causes:

1. The stress axes (on which the center of area of each cross-section lies) of the members which come together may not meet in a point (Fig. 10a). There is a bending moment

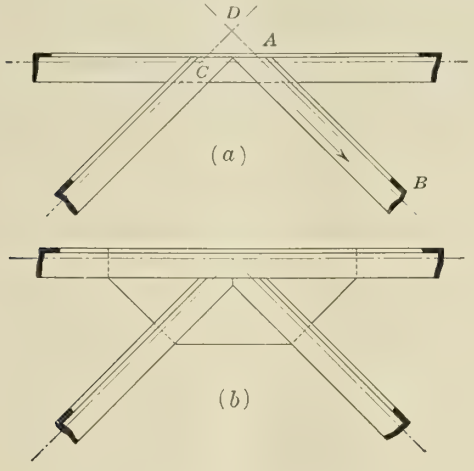

Fig. 10

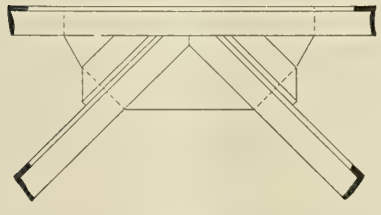

Fig. 11

at this joint equal to the pull in *AB*, multiplied by the arm *CD*, taking moments about *C*. This develops an extra shear in the connecting rivets. This fault is corrected by arranging as shown in Fig. 10b.

2. Members may not be loaded or attached symmetrically about their stress axes. We must avoid any eccentricity of stress in the attachments, which sets up extra shear in the rivets. The difficulty experienced in making an angle-bar connection is that of grouping the rivets symmetrically about the stress axis. To develop its full efficiency, an angle bar should be attached through both flanges (Fig. 11); unless this is done, only one flange can be taken into account when the member is in tension. If symmetry of rivets about the stress axis is unattainable, then the center of area of the rivets should lie on this line. For members meeting, the center of area of all the rivets in the connection should coincide with the intersection of the stress axes of the members.

3. Members may not be free to rotate about the joint when the loads come on, and must therefore deflect as the structure deflects. This is unavoidable with riveted joints, but, on the whole, the fixing of the joints is desirable in structures of moderate size, such as those with which we are dealing. The tension members, due to bending, owing to their ends being fixed, have more stress than that given by the reciprocal diagram which assumes pin-jointed ends, but the fixing of the ends of the compressive members strengthens them, so that their actual stress is less than that got from the reciprocal diagram. If the diagonal members are riveted where they cross, the effective length of the strut is reduced by a half, and so strengthened. It would be well to avoid the use of flat bars for tension members, although each panel is counterbraced, and to design the bracing so that it will act either as a tie or a strut, as is required by different distributions of loading.

Longitudinally Framed Vessels

To adapt what has already been said to longitudinally framed vessels, we must interchange the terms "floor" and "longitudinal." The "floor" may be taken as being made up of sections stretching between two adjacent bulkheads which support its ends simply.

Among other parts of the vessel where the open-web principle might be adopted with advantage might be mentioned partial bulkheads; middle-line non-watertight bulkheads when fitted in lieu of pillars; beams and beam connections of non-pillared vessels, etc. The last mentioned might be treated as a built-in beam of uniform strength, *i. e.*, whose strength at any point is proportional to the bending moment at that point; the half beams would be treated as cantilevers of uniform strength.

Tug Boat for Atlantic Coast Towing Trade.—The Staten Island Shipbuilding Company, Port Richmond, Staten Island, New York, launched July 22 the steel tug boat *W. B. Keene* for the Hillton-Dodge Lumber Company of New York. The hull is 150 feet long, 27 feet 6 inches beam and 16 feet 6 inches depth of hold. Propulsion is by a triple-expansion engine of 1,100 horsepower supplied by steam at 180 pounds' pressure from two Scotch boilers. The auxiliaries include a Williamson steam-steering gear, a powerful electric plant and improved fire and wrecking pumps. As soon as completed the tug boat will be engaged in towing the company's new barges between the Southern lumber ports and the Northern markets.

The Oldest Vessel in Commission.—In an article on page 372 of the September, 1909, issue of International Marine Engineering, the claim was made that the Danish sloop *Constance*, formerly an American yacht, was the oldest vessel in commission in the world. At the time this article was written the vessel was owned by Mr. J. Jeusen, of Lohals, Denmark, and had been in his possession since 1889. We are now informed that this ancient vessel has just been sold to a fisherman of Skaw in Jutland. The *Constance* was built in 1723 and is of 35 gross tons, the length being 52 feet 6 inches and the breadth 14 feet 8 inches.

Ore Shipment on the Great Lakes.—The amount of iron ore brought down the Great Lakes from the Lake Superior region in July totaled 8,204,416 gross tons, as compared with 7,600,233 tons in the same month a year ago. This establishes a record not only for the month of July in any year, but for any previous month, as it is the first month in which the figure of 8,000,000 tons has been reached or passed.

New Incandescent Lamp.—A new type of incandescent lamp is to be placed on the market by the General Electric Company, which, it is claimed, consumes only about half as much current per candle power as the present "Mazda" type of lamp. In the new lamp the tungsten filaments will be of a special shape and filled with an inert gas at a pressure of about one atmosphere.

Large Dry Dock at Quebec.—The Canadian Government is to provide a dry dock 1,150 feet long by 137 feet wide and 40 feet deep at St. Joseph de Levis, opposite Quebec, at a cost of $2,750,000 (£550,000). The contract for the construction will be carried out by Mr. H. P. Davis, of Montreal.

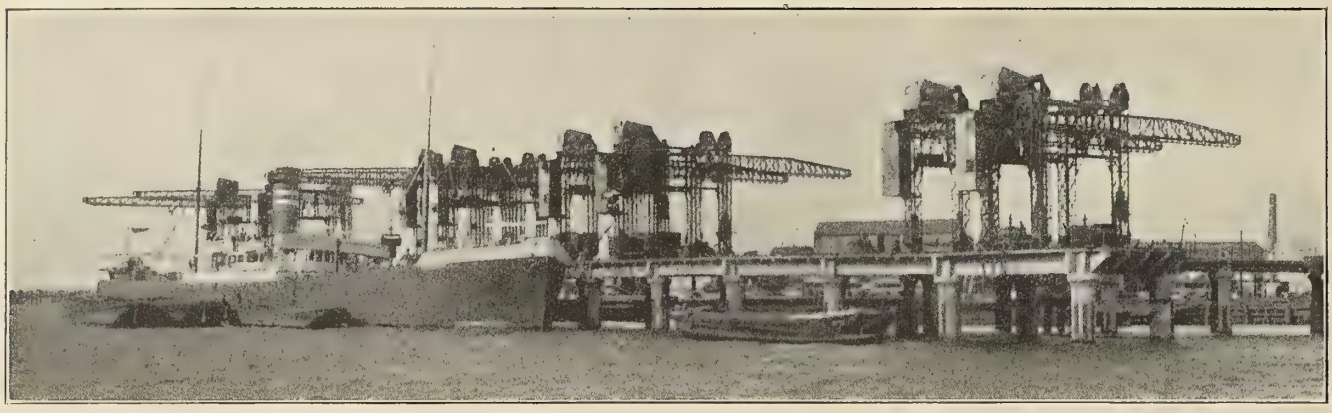

FIG. 1.—INSTALLATION OF EIGHT CRANES AT DAGENHAM DOCKS

The Transfer of Coal To and From Ships

One of the chief costs in connection with sea-borne coal is the cost entailed in transferring the fuel from the railway truck to the hold of the vessel, and from the vessel to the works where it is to be utilized. The operation of bunkering the ship also is one which is not infrequently attended with considerable difficulty, especially in ports where due attention has not been paid to the provision of modern appliances, rendering a quick and easy transfer possible.

The designs of cranes and transporters for handling coal in connection with ships is a branch of engineering possessing many special points which place it in a class by itself, and to a greater extent than is perhaps realized even by engineers, a call has been made for apparatus to meet the conditions arising out of the immense traffic in sea-borne coal which has developed more especially during the last few years. It is for this reason that it is of interest to refer to two typical coal-handling installations which present numerous features of outstanding interest in order to show the specialization which has taken place in connection with the transfer from land to water or vice versa. We are indebted for these types to the courtesy of Messrs. Babcock & Wilcox, Ltd., of London, who have during recent years made a special study of this question and have manufactured machines which possess a considerable number of novel features.

The first installation to which we may refer is that which has been installed recently in connection with the Dagenham Dock, Essex. The type of transporter which is installed there can be studied from Fig. 2, showing a three-ton electrically operated transporter crane designed for handling 100 tons of coal per hour. It will be seen that this design is a combination of an ordinary transporter and a jib crane, and it has a considerable number of special points which render it more efficient than either a jib crane or a simple transporter.

The view shows the jib or horizontal boom in its mid position, and it will be observed that, owing to the bridge construction adopted, the quay space is reduced to a minimum. Practically the whole width of the quay is available for railway wagons and the like, the crane traveling along two rails

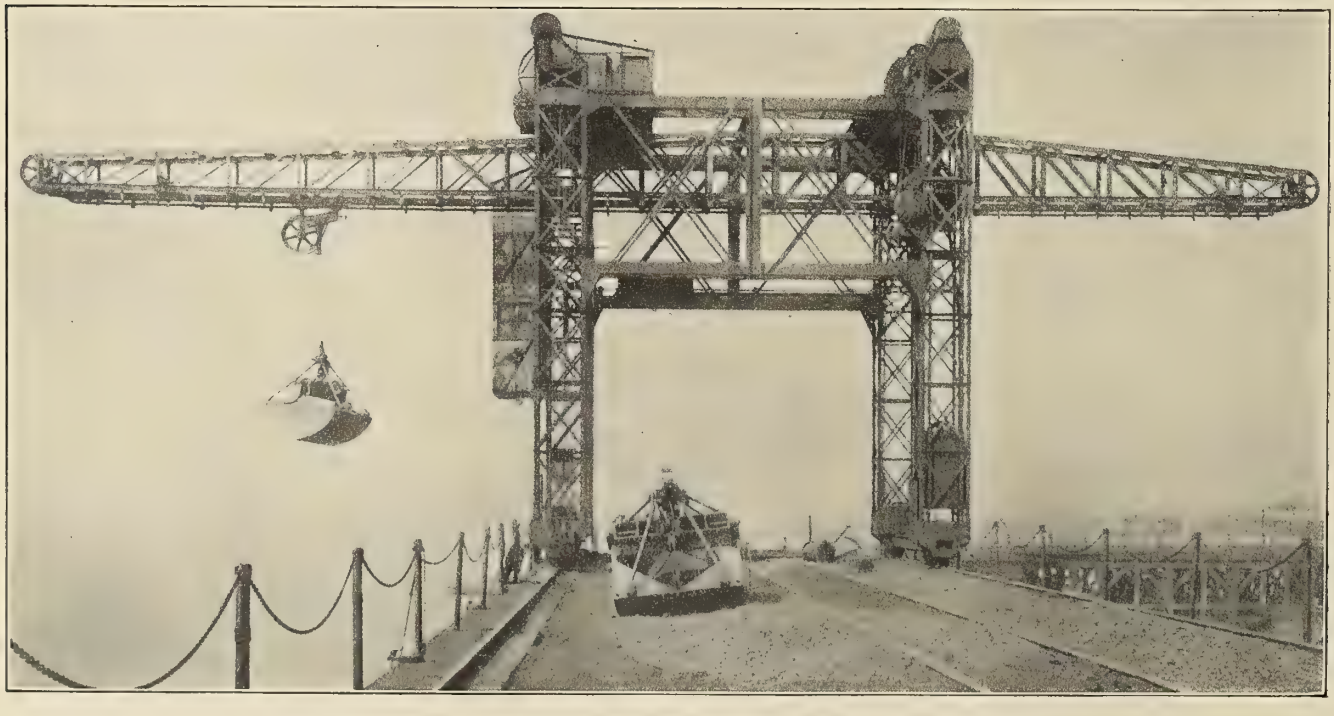

FIG. 2.—THREE-TON, ELECTRICALLY-OPERATED TRANSPORTER CRANE AT DAGENHAM DOCKS

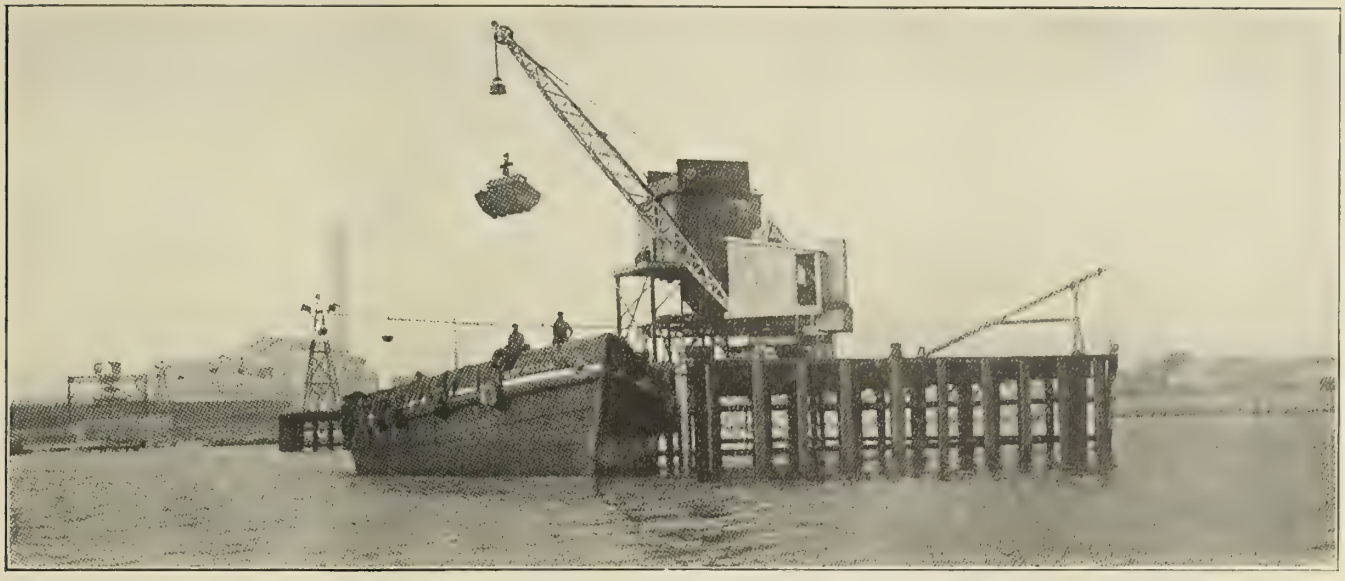

FIG. 3.—2½-TON COALING JIB CRANE AT THE USINA ELECTRICA, MONTEVIDEO

placed close to the edge of the quay, the vertical supports being comparatively narrow, and yet sufficiently rigid to give the crane great structural strength. Facilities are given to clear the masts or spars of a steamer lying alongside the quay by making the jib capable of being moved transversely in either direction.

The material is handled by grabs working on the double-rope system, the transverse motion of the grab being obtained by means of a jinney which travels along the boom. The grab is capable of being opened or closed in any position, and from actual figures it has been found that one machine is capable of handling 100 tons of coal per hour, or, working over a whole ship, about 60 tons per hour.

An important feature in connection with the crane is that the weight of the grab is balanced for all movements. This is of particularly great advantage, as it enables the size of the electrical equipment to be reduced to a minimum.

In addition to this, the machines are operated by means of a patent electric motor, which is so designed that either the armature revolves and the field remains stationary, or the field revolves and the armature remains stationary. In this way a forward or reverse motion is obtained without reversing the motor, and this novel and ingenious system of control reduces the complication of the electrical equipment to an absolute minimum.

The various motions are controlled by two hand levers, and a foot pedal controls the opening and closing of the grab. The hand levers also control the movement of the jib inwards and outwards, while an extra lever is provided for controlling the longitudinal traveling of the whole structure.

Fig. 1 shows a general view of the whole installation of eight cranes installed at the Dagenham Docks, with a ship alongside ready for unloading, and the utility of the arrangement will be at once apparent from the illustration. It may be mentioned that at the present time two large transporters of this type are being erected in South America.

FIG. 4.—INTERMEDIATE STAGE OF COALING STATION AT MONTEVIDEO

Another interesting type of coaling equipment is shown in Figs. 3 and 4, these being views of the equipment in connection with the Usina Electrica at Monte Video. Fig. 3 shows the installation from the seaward end, and it will be seen that there is installed at the pierhead a 2½-ton electric coaling jib crane of the single motor type, having a radius of 32 feet 9 inches. This grabbing jib crane on the pier lifts the coal from the boats moored alongside and deposits the fuel in the hoppers which serve the ropeway passing landward, as will be seen in the middle distance to the left of the illustration.

Turning to Fig. 4, the intermediate stage of the installation is seen. This consists of a coal silo of large capacity, forming a coal storage for the power station which is seen in the background of Fig. 3. Over this coal storage is a three-motor goliath crane of 1½-tons' capacity and having a span of 49 feet 2½ inches. It will be seen that this crane is fitted with a bunker and duplicate shoots, and is capable of traveling outward the whole length of the silo. It also supports the loading and unloading station for the ropeway, which will be seen traveling from the pierhead in the sea to the left of the power house. This ropeway is 480 yards long between terminals, and is capable either of transporting coal from the ship, unloading coal out on the pier and the coal silos, or from the coal silos to the power station or alternatively direct from the ship unloading crane to the power station. By means of this arrangement it is seen that coal can be deposited in the silos from the duplicate shoot, it being received by the goliath crane from the ropeway. When there is a demand for coal at the power house and a ship is not available for immediate supply, the goliath crane operates by means of the grab and transfers the coal from the silo to the ropeway passing to the station. Where storage is not necessary, the buckets of the conveyor simply take the coal direct through to the station. It will be seen that by this arrangement a complete and comprehensive coal-supply system for the power house is obtained with a minimum of heavy structural work, while giving very great flexibility in the handling of the fuel, and is therefore an outstanding type of efficient coal-handling apparatus from ship to shore.

These two installations are sufficiently typical of the progress which is now being made in this department of engineering, and should therefore be of interest to all who are concerned with coal carrying or coal bunkering. The installations are therefore described at some length as indicating material British practice in this respect.

Shipbuilding in Japan

According to the annual report of the Japanese Mercantile Marine Bureau for the year 1911-1912, there were in Japan at the end of the year 2,844 steamers, of 1,386,534 gross tons; 8,192 sailing vessels, of 451,520 gross tons; and 21,817 junks. Compared with the preceding year, these figures show an increase of 299 steamers, of 152,625 tons, and of 1,800 sailing vessels, of 37,800 tons, and a decrease of 826 junks. Of the registered vessels, the increase, owing to new construction or other causes during the year, was 199 steamers, of 173,644 tons; 884 sailing vessels, of 40,803 tons, and 32 junks. On the other hand, the number of vessels lost by sea disasters and other causes was 48 steamers, of 23,300 tons; 256 sailing vessels, of 19,417 tons, and 210 junks.

At the end of the year there were 216 shipbuilding yards, excepting junk builders. Compared with the preceding year, this shows a decrease of 14 in number. The number of vessels, however, turned out by these yards during the year was 142 steamers, of 41,229 tons, and 216 sailing vessels, of 13,132 tons, which, in comparison with the preceding year, shows an increase of 65 steamers of 16,750 tons and 69 sailing vessels of 2,035 tons. The number of vessels inspected during the year was 3,409 steamers, of 3,446,470 tons; 2,626 sailing vessels, of 237,654 tons, and 199 junks. This, compared with the preceding year, shows an increase of 203 steamers, aggregating 206,524 tons, and 194 sailing vessels of 1,486 tons, while the junks inspected were less by 159 in number, aggregating 63,797 tons.

The very satisfactory growth in the Japanese mercantile marine is due very largely to the government aid furnished to shipbuilding, navigation and the subsidized steamship lines. Altogether, the number of ships completed during the fiscal year, with the grant of "Shipbuilding Encouragement Certificate," in accordance with the provisions of the law for the encouragement of shipbuilding, was 11, aggregating 50,550 tons. The number of ships to which the "Certificates" were granted, but which were not completed during the fiscal year, was 10, aggregating about 49,450 tons. The number of ships to which the "Navigation Encouragement Certificates" were granted in accordance with the law for the encouragement of navigation during the fiscal year was 17, aggregating 73,540 tons, the routes covered by these vessels including those to Europe, North America, Singapore, Ocean Islands, Hongkong, Bombay and China.

The subsidized lines coming under the direct control of the Mercantile Marine Bureau were 24 in number at the end of the fiscal year, including those lines operating on the European, North American, South American, Australian, China, Oriental, Japan Sea and home routes. Furthermore, there were at the end of the fiscal year 24 lines coming under the control of the Prefectural Authorities, and in nearly every case where orders granting subsidies to any of these lines expired during the year the orders were renewed for the same shipping companies and shipowners.

Some idea of the prosperous condition of the subsidized companies and corporations connected with Japanese shipping can be obtained from the following statements made in the Mercantile Bureau's report: The Nippon Yusen Kaisha's 26th yearly balance (October, 1910, to September, 1911) showed receipts of 28,120,599 yen; disbursements of 23,724,397 yen, and a net profit of 4,396,202 yen. Compared with the preceding year, there was an increase of 345,619 yen in net profit. The Toyo Kisen Kaisha showed a profit for the year of 716,573 yen, which, in spite of the fact that the company's receipts showed an increase of over 900,000 yen, as compared with the preceding year, nevertheless showed a decrease of 361,988 yen in net profit, as compared with the preceding year. As for the Osaka Shosen Kaisha, whose net profits for the year amounted to 1,952,822 yen, there was an increase of 712,323 yen in net profit over the preceding year. Similarly, the fifth yearly figures for the Japan-China Steamship Company, which realized a net profit of 586,049 yen for the year, showed an increase of 22,569 yen in net profit over the preceding year.

NEW MOTOR SHIP.—The second motor ship for Rederiaktiebolaget "Nordstjernan," Stockholm, was launched at the yards of Burmeister & Wain, Copenhagen, June 21. This ship, which is named *Pedro Christoffersen*, is a sister ship to the *Suecia*, and is 362 feet long, 51 feet 3 inches beam, 25 feet 6 inches depth, with a draft of 23 feet 1 inch, and a deadweight-carrying capacity of 6,550 tons. Propulsion is by two four-stroke Diesel engines, developing a total of 2,000 indicated horsepower. On August 1 this vessel was taken out on her official trial trip; the engines at that time had been tried only once before on board the ship while she was lying at the dock. The official trip proved satisfactory to the owners, who took immediate possession of the ship, sending her at once to Sweden for cargo. During the trial trip the oil consumption was found to be 176. 5 Gr. per brake horsepower per hour, including the consumption for all the auxiliary machinery, steering gear and lights. The satisfactory result was obtained in spite of the fact that the oil was of poor quality, having a heating value of only 9,900 calories.

McAndrew's Floating School

BY CAPTAIN C. A. McALLISTER*

CHAPTER XIII

Feed Water Filters, Pumps and Injectors

"Having followed the steam along until it is condensed into water, our next step will be to get it back into the boiler, ready for its transformation into steam again; incidentally we will stop at one or two of the way-stations, as they say on railroads.

"After the water leaves the hot well or the air pump, it is usual to subject it to a filtering process in order to remove the grease and other impurities which become mixed with the steam as it passes through the engine. Impure water is just as bad for boilers as it is for human beings: while an occasional dose of oil is said to be good for the human system, it is never good for a boiler's 'system,' hence every effort is exerted to keep it out of the feed water. Most ships are fitted with what is known as a filter tank, which serves the double purpose of a reservoir for the feed water and a receptacle for filtering materials.

"The filter tank is customarily fitted with a number of compartments through which the feed water is drawn by the action of the feed pump—usually going up in one compartment and down in the adjoining space. By this means for a distance of from four to ten feet, according to the size of the tank, it flows through the filtering material, and the oil is supposed to be caught thereby. The material most commonly used is 'excelsior' (small wooden strings), because of its fairly good qualities for absorbing or entrapping the grease globules as well as its very cheap cost. Ordinary hay is sometimes used, but it is not as efficient as the excelsior. Sponges are used to some extent, but they are so expensive that they cannot be thrown away after becoming oil-soaked, and cleaning them to be used again is not a job relished by the oilers and firemen. A spongy vegetable substance known as 'loofa' is occasionally used, but that too is expensive and has to be washed out and replaced in the compartments. There are several patented filters on the market which utilize various woven filtering materials, such as gunny sacks, etc., but they are all for the accomplishment of one object—the removal of grease and oil, the only real, thorough cure for which is to refrain from its use entirely."

"That," interrupted O'Rourke, "is like curing a mad dog by cutting off his tail close up behind his ears."

"You have the idea all right, but you will find that both these remedies are difficult of accomplishment," answered the instructor.

"Now as to the feed tank's use as a reservoir—it should have an ample capacity for at least five minutes' supply of feed water for the boilers when the engine is running at full speed, in order to allow for the fluctuations between supply and demand in all steam plants. When feed pumps were located in the fire rooms, water tenders would have to run back and forth to see that the water in the tank was not so low that the feed pump was pumping air into the boilers, or else not so high as to be overflowing into the bilges. The proper system is to have the feed pumps located in the engine room as near as practicable to the feed tank, then by means of a float, rising and falling with the level of the water, and connected by means of rods and bell cranks to a micrometer valve in the main feed pump steam line, the system is so regulated that the water level in the tank can be automatically adjusted.

"We are now up to the subject of boiler feeding, and in this connection I will ask you: How does your supper to-night compare in importance with feeding the boilers?"

"We get our feed and some money besides, while as far as I can see all a boiler gets is its feed," said Pierce.

"No, that isn't it," broke in O'Rourke, "a boiler lives on liquid food and has to be fed all the time it is working, while we have to work all day and only get fed once in a while—and it's pretty bum stuff at that. Mr. Boiler, though, has to have his feed of the purest brand."

"That's true," replied McAndrew, "but you must remember that the boiler's stomach is only of steel, while from what I hear, you have a copper-lined stomach.

"However, I am glad that you appreciate the fact that a boiler has to be fed continually while it is working, as that is the most important thing an engineer has to contend with. If anything goes wrong with the main feed pump there is the dickens to pay, as the boiler's appetite for water allows of no delay.

"On most ships there are at least three means of forcing in the feed water—the main feed pump, the auxiliary feed pump and the injector. It would be a rare series of accidents, indeed, when at least one of these contrivances would not be available for feeding purposes.

"The most important is, of course, the main feed pump, as that has to do the brunt of the work. It is customary to make this pump of the duplex type—that is, having two steam cylinders and two water cylinders, so arranged that the valve gear of each steam cylinder is worked from the crosshead of the other pump. Some engineers prefer the simplex type, and, in my opinion, there is really very little choice, except that the simplex type costs less and occupies comparatively less space. The choice between horizontal and vertical pumps is also largely a matter of opinion, as there are engineers of equal standing who have preference for both types. The best feed pump is the one that gives the least trouble and is the most reliable, no matter whether it is simplex, duplex, horizontal or vertical."

"Which one is it?" inquired Schmidt.

"That's something you will have to learn for yourself, from your own practical experience," answered McAndrew. "I have heard good engineers argue themselves black in the face as to the relative merits of different types of pumps, and at the end neither convinced the other that he was right.

"Everybody will, however, agree that a main feed pump should be made as simple and strong as possible; that its water cylinders should be made of solid composition if you can afford it; that its steam valve gear can be readily adjusted, and that it keeps running constantly without much watching."

"How is it," inquired Nelson, "that a pump using steam of boiler pressure can force water into the boiler against the same pressure?"

"That is very simple," replied McAndrew, "as a boiler feed pump is somewhat on the principle of a lever—that is, the steam cylinders are always larger than the water cylinders. For example, a common proportion for an ordinary feed pump is to have steam pistons 8 inches in diameter driving water pistons or plungers 5 inches in diameter. Nelson, what would be the leverage in a pump proportioned like that?"

"Why, let me see," replied Nelson. "Oh! Yes, it would be 1 3/5 times as much pressure on the steam piston as it is against the water piston."

"Oh, no!" smilingly said the instructor, "you are wrong—we are not dealing with straight lines in this case; if it were

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a bar lever we were using to force the water into the boiler your answer would be correct, but cylinders have circular pistons, so the proportion between them varies with the squares of the diameters."

"What's that mean, sir?" said Nelson.

"By the square of any number is meant the product obtained by multiplying the number by itself. Thus the square of 5 is 25 and the square of 8 is 8 times 8, or 64; hence the leverage we gain in this particular pump is equal to 64 divided by 25, or 2.56. In other words, there is a load on the steam piston of 2.56 times that necessary for the water piston to exert a force equal to the boiler pressure. This proportion is found to be ample to insure the water being forced into the boiler against the boiler pressure, friction in the feed pipes, check valve, etc. Always remember the rule I have given you about comparing things having circular sections and you won't fall into the error I once saw a man make of fitting two 2-inch drains to carry off the water put into a tank by one

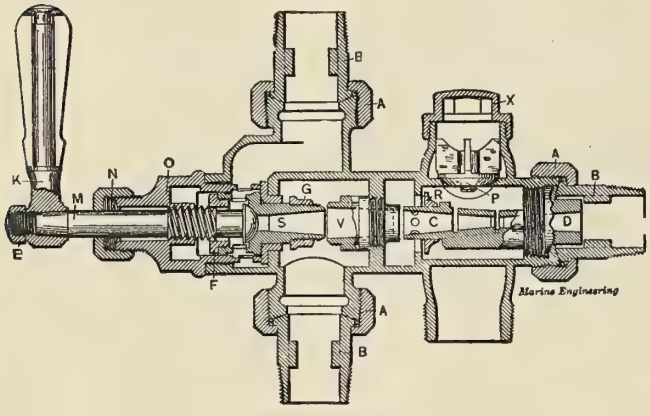


FIG. 24.—INJECTOR

4-inch supply pipe. Tell me quickly, O'Rourke, how many 2-inch drains should he have fitted?"

"Four, of course," replied the Hibernian.

"Fine work!" said McAndrew.

"A good guess," sneered Schmidt.

"There is usually only one suction pipe and one discharge pipe to the main feed pump, so that it will draw water from the feed tank and discharge into the main feed line only. There can then be no complication and no danger from opening the wrong valves when the pump is first started up. A properly proportioned pump should work easily and quietly.

"The auxiliary feed pump is, as you probably know, used in case the main feed pump breaks down. Many people call this the 'donkey pump,' just for what reason I do not know."

"I know why that old pump on this ship is called a 'donkey' —it's because it bucks and kicks so much," suggested O'Rourke.

"It must do that when you are running it, then," retorted McAndrew. "I never saw it act that way. It's all in knowing how to run a pump—you probably tried to start it without opening any of the discharge valves. I think the 'donkey' must have been on the other end.

"The 'donkey pump' is, of course, used for many other purposes than as a boiler feeder. It generally has four or five suctions and as many discharges. It can be used for pumping out the bilges, pumping out the boilers, for fire purposes and for washing down decks. When you use this pump you must be very careful to see that you open the right valves. I remember catching one oiler who was on this ship pumping bilge water into one of the boilers simply because he had opened the wrong suction valve. I fired him at once, as there is no place on this or any other steamship for such careless people.

"The auxiliary or 'donkey' pump is frequently a duplicate in construction of the main feed pump, but if possible the water end should be of composition on account of handling salt water. On all well-designed feed pumps there is an air chamber, both on the suction and discharge sides. These answer the purpose of a cushion for taking up the shock. Water is practically non-compressible, so that a sudden stroke of the pump acts like a hammer on the whole pipe system unless there is an air chamber wherein the air is compressed like a spring. No work is lost, but the shock of impact is prevented.

"There is another method of feeding water into a steam boiler besides the main and auxiliary feed pumps, and it is of such importance that every ship should be fitted with at least one. This is known as the 'injector'—an apparatus which occupies very little space but is highly efficient and often very useful. Fig. 24 is a sketch of an ordinary type.

"In the figure shown, the steam is admitted through the pipe *B*, the entrance to the body of the injector being controlled by the valve which is operated by the handle *K*. When this valve is opened, the steam rushes through the contracting nozzle *S*. The air in the space around the two openings shown is mixed with the steam and forms a partial vacuum sufficient to draw in the water through the pipe *B*. This water combines with the steam and passes into the combining and delivery tube *C D*. The steam is condensed in this tube by contact with the water, and the jet thus formed is given a very high velocity, ample to lift the check valve and force it into the boiler. It is really the energy of the inrushing steam which gives the water sufficient momentum to carry it into the boiler. The great advantage of such a device is that it acts as a feed water heater, the water going into the boiler being heated by the steam which gave it the momentum.

"For some reason or another, people who locate injectors never seem to get them piped up right. They should be arranged so that the lift of the water will be very small—not over 4 or 5 feet at the greatest—and the discharge pipe to the boiler should be as direct as possible so as to avoid any sharp bends. You have all heard the expression that 'four round turns are equal to a blank flange.' That is not exactly so, but it is nevertheless true that every round turn or right-angled bend in a pipe greatly increases the friction of the water passing through it.

"In recent years engineers generally recognize the great advantage of a feed water heater, so that no new vessel is turned out without one of these aids to economy. Ten or fifteen years ago it was not generally the practice to fit a device for warming the feed water, but now one of the greatest problems which confront all marine engineers is to get the greatest amount of work out of the least amount of coal. No single apparatus connected with marine machinery has done more to produce economy of fuel consumption than the feed water heater, a device primarily to utilize heat which has heretofore been wasted through the discharge water from the condenser. Many devices have been invented to heat the feed water by means of the waste gases from the furnaces, but the liability of accidents to the piping thus employed has practically put them out of use. Hence, nowadays, it is almost the invariable practice on steam vessels to have the feed water heated by means of a portion of the exhaust steam from the auxiliaries, such as the dynamos, feed pumps, air pump (when independent), etc. The best form of feed water heater of this class is where the steam does not come in contact with the feed water. In other words, the modern feed water heater is practically a small surface condenser where the feed water is the circulating medium. These are of various types, some having straight tubes with tube sheets like an ordinary condenser, and others having spiral coils connected to manifolds at the ends. Heat from the exhaust steam is thus transmitted to the feed water, so that it is possible to have the feed water enter the boilers at as high a temperature as 240 or 250 degrees Fahrenheit."

"I thought water boiled at 212 degrees," suggested one of the class.

"So it does," said McAndrew, "under atmospheric pressure only, but I have previously pointed out to you that the boiling point of water varies with the pressure, and in this case the pressure of the feed water is higher even than that of the steam in the boiler."

"Where does all the saving come in?" inquired Nelson.

"I'll show you," said the instructor, "as it is quite simple. We will suppose that we are using steam at a boiler pressure of 180 pounds per square inch, and that the feed water we have been using is only 100 degrees, rather cold, but still it is such as is sometimes used when great care is not exercised by regulating the circulating pump. Now suppose we have yielded to common sense and fitted the vessel with a feed water heater of the exhaust steam variety, and we find by the thermometer in the feed pipe that the water is entering the boiler at an actual temperature of 230 degrees Fahrenheit. We have thus caused a gain of 130 degrees Fahrenheit. From the 'Steam Tables' we find that steam at 180 pounds pressure contains 1,198 B. t. u. By a simple calculation we then find how much is saved, thus:

Total heat in 1 pound of steam	1,198
Heat in feed water as used originally (100 — 32)	68
Heat required to form 1 pound of steam under old conditions	1,130

Under the new conditions we have saved 230 — 100 = 130 B. t. u.'s, and we find that we now only have to use 1,130 — 130 or 1,000 B. t. u.'s for a pound of steam. To find the ratio of saving we divide 130 by 1,130 and it gives 11.5 percent. Thus, if the ship has been using 100 tons of coal for a certain run between ports, it will be found after the feed water heater is fitted that 88.5 tons will do the same work. At $3 (12s. 6d.) per ton there will be a saving each trip amounting to $34.50 (£7 3s. 9d.). For 100 trips a year the saving in coal would be $3,450 (£707), or more than enough to pay for the new heater the first year it is used.

"The saving in fuel is not the only benefit to be derived, as the use of hot feed water undoubtedly prolongs the life of the boiler and prevents many leaks in the seams which result from the use of cold feed water. We might compare the bad effects of the use of cold feed water in boilers to the bad effect on a man's health of drinking too much ice water."

"Would it make his seams leak?" asked O'Rourke.

"No. But it often makes his stomach ache, and he will not last as long as the man who slakes his thirst with water only moderately cold.

"We have now followed the feed water through its various manipulations, and it is prepared to enter the boiler, except for one important essential, and that is taking the air out of it. Many of the ills which befall the interior surfaces of boilers are due to the air which enters with the feed water. There is not in general use any simple device to accomplish this, however, as designing engineers, as a rule, do not pay much attention to this important matter. If a pet-cock is fitted at some bend in the pipe, or if some obstruction is fitted in the pipe, considerable of this air can be blown off, and there are also certain automatic devices which can be used for blowing out the entrapped air. In watertube boilers where the feed water enters above the surface of the boiler water in the steam drum, the air is released to a considerable extent by having the feed water discharge against a small hood over the feed pipe nozzle, so that it enters the boiler in a spray, the air becoming separated and being carried off with the steam. There can be little corrosion in boilers without the oxygen in the air, so that the exclusion of air from the water tends greatly to reduce the pitting and corrosion.

"The feed pipes leading from the feed water heater to the boilers are usually made of seamless drawn brass or copper, and should run as nearly straight as possible to avoid friction. These pipes, as far as possible, should be run where they are easily accessible in order to detect any leaks, and by all odds the joints should be located where they will be easily accessible for putting in new gaskets, as a leaky joint in a feed pipe is intolerable."

"What's that?" said O'Rourke.

"That means something that we cannot stand for, very much like some of your questions."

(To be continued.)

On Safety of Life at Sea*

BY PERCY A. HILLHOUSE

Human life at sea is on the average exceedingly safe. Recently published figures show that during the twenty years—1892-1911—some 95,000 voyages were made between Britain and America, about 350,000 crew and over 9,390,000 passengers having started. Only one out of 332 of the crew and one out of 117,400 passengers did not reach their destination in safety. About two-thirds of the total number of casualties are found to be of a minor nature, involving comparatively small loss of life, while the remaining one-third accounts for 83 percent of the total loss.

Of all the causes of loss of shipping, that over which the naval architect can probably exercise the greatest control, is that of foundering, whether through stress of weather or as the result of collision with any obstacle whatever. The proper regulation of freeboard has a very important bearing upon such disasters. Statutory freeboard is designed to insure a suitable proportion of reserve buoyancy, and takes into consideration the type of vessel, her strength, and the extent of her erections. In most cases it determines the height of the watertight bulkheads above the load waterline, and this margin, together with the spacing of the bulkheads longitudinally and the water-excluding properties of the machinery, the coal and the cargo carried, are the elements which determine the amount of flooding which can be endured without submerging the tops of the bulkheads and so leading to total sinkage. In most large passenger vessels of modern type, the number and extent of the erections above the bulkhead deck affords also a height of platform above water which greatly reduces the danger of structural damage and loss of life due to seas finding their way on board.

Subdivision of the hull into separate watertight compartments is, in conjunction with the provision of a suitable freeboard, the most valuable means at the disposal of the naval architect towards limiting the amount of sinkage consequent upon any given extent of damage to the shell plating. Increased safety may be obtained by means of transverse bulkheads in two ways. Firstly, by increasing their height so that the vessel may sink more deeply before their tops become submerged. This was done in the celebrated *City of Paris* and *City of New York*, and is equivalent to increasing the freeboard to the bulkhead deck. The method is apt to interfere with the passenger accommodation, and unless many watertight doors are fitted, results in much inconvenience in the working of the ship. It is largely a question of convenience versus safety. Secondly, by decreasing their spacing, fitting more bulkheads, and so reducing the sizes of the holds and 'tween decks. This also tends to interfere with cargo and passengers, and increases the numbers of cargo hatches and stairways required. It should be noted, in this connection, that it is not so much a question of the *number* of adjacent compartments that may be simultaneously flooded with safety as the *proportion* of the ship's length which may suffer damage. If a ship's side

* Abstracted from a paper read before the Institution of Naval Architects, Glasgow, June, 1913.

be ripped open for any given length it is of little consequence into how many compartments that length may be subdivided. All will be laid open, and the result will be the same whether the vessel be a "two-compartment" or a "three-compartment" ship. When a ripping blow occurs the *average* length flooded will be equal to the length of the rip plus the length of one compartment, and the *maximum* length laid open will be when each end of the rip lies on a bulkhead. In this case the length flooded will be two compartments more than the length of the side cut open. The smaller the compartments, therefore, the less will be the amount of flooding, and to this extent only is a "three-compartment" ship likely to be better than a "two-compartment" design if the extra safety is obtained only by closer spacing, and not also by increased height of bulkhead.

In cases of collision with another vessel, in which it may fairly be assumed that only one transverse bulkhead will suffer damage, and, consequently, not more than two adjacent holds flooded, the vessel having the closer bukhead spacing will, of course, have the advantage, since a less volume of water will be admitted.

Great care requires to be observed when introducing longitudinal bulkheads as a means of limiting the extent of flooding, on account of the fact that water admitted to one side of the ship only will produce a heeling tendency, which may have the effect of bringing the tops of the bulkheads upon that side nearer to the water surface than would be the case were both sides simultaneously open to the sea. In spite of the loss of water plane area, the vessel's stability in the flooded condition will usually be greater than when intact, on account of the increased height of the center of buoyancy, and this fact is of much value in reducing the amount of heel produced by unsymmetrical flooding. Longitudinal subdivision is commonly obtained either by means of middle line bulkheads in machinery and cargo spaces, by wing bulkheads in engine-rooms, and between boiler-rooms and side bunkers, or by carrying the double bottom well up the vessel's sides so as to form an inner skin. Of these three methods, that of wing bulkheads appears to be the most valuable, as the wing spaces are less than those on one side of a central bulkhead, and greater than those between two skins. The central spaces containing the machinery and boilers are less likely to be rendered useless, and the wing bulkhead, being further from the vessel's side than the inner skin, is less liable to partake of any damage occurring to the outer shell plating. In cases where wing bulkheads are fitted it will probably be found advisable to interconnect the wing compartments on either side of the ship, so that both may be filled at the same time, and the vessel thus kept upright.

There are many objections to the fitting of an inner skin in mercantile vessels. Wing bulkheads already serve a useful purpose of bunker boundaries, and so do not add materially to the vessel's weight or cost; but an inner skin is a definite addition to both—it reduces the space available for cargo, coal, machinery and passenger accommodations—and on account of its comparative nearness to the ship's side is difficult to dissociate from any damage occurring to the outer skin.

Watertight decks form an exceedingly valuable form of subdivision. Very little additional weight is involved, as the deck is already required for other purposes. If the deck is above the waterline and between passenger accommodation and cargo spaces, its conversion into an effective watertight division is comparatively simple, and the only alteration involved is that of enclosing the cargo hatches by watertight trunks extending up to the bulkhead deck. If, however, there happens to be passenger accommodation below the watertight deck, it becomes necessary also to carry watertight exit stairways up to the bulkhead deck, and in most cases this would mean a considerable amount of inconvenience to passengers. Watertight doors may, of course, be fitted on such stairways, but these should be avoided as far as possible, since every additional opening affords passage to water should the closing of the door be overlooked or found impossible in case of sudden emergency.

In considering the position of the waterline to which the vessel is estimated to sink after any supposed flooding, special attention requires to be given to the possibility of water entering non-damaged compartments by way of scupper pipes, slop sheets, sanitary discharge pipes, and so on. The storm valves fitted where such pipes pass through the vessel's side are not absolutely watertight, and should the upper ends of the pipes fall below the external sea level, water may easily find its way inboard. Screw-down covers should be fitted in all such cases, and as the rate of flow would not be great, time would be available for the closing of each pipe before much additional water had entered the vessel.

The whole success of the method of subdivision hangs also upon the prompt and efficient closing of all watertight doors as soon as an accident has occurred. There are now upon the market several excellent systems by which all doors can be closed from the bridge, and in which any door is closed automatically by the rise of water on either side of the bulkhead.

In the last resort, when all else has failed, and it becomes evident that it will be necessary to "abandon ship," the safety of life at sea will depend upon the amount and nature of the "life-saving appliances" with which the vessel is equipped. It is now a generally accepted axiom that lifeboat accommodation should be provided for every person on board. The ideal life-saving appliance is one that is simple and certain in its action and by which large numbers of people can be floated safely and quickly. The whole subject has been under the careful consideration of the Boats and Davits Committee, and their final report has recently been made.

Briefly put, its most important recommendations are as follows:

The number of persons to be allotted to any open lifeboat is to depend upon its stability and upon its actual capacity as determined by Stirling's rule, instead of upon the overall dimensions and an assumed coefficient.

Development may safely be in the direction of larger boats, say 50 feet by 15 feet by 6 feet 8 inches, each carrying 250 persons and weighing 28 tons when loaded.

Decked lifeboats to have permanent bulwarks fitted with buoyancy tanks; they may be "nested" two or three deep, even although it may be necessary to raise them out of the nest by means of hand winches before they can be moved under davits.

Pontoon rafts may be accepted for 25 percent of the persons for which the ship is certified.

In foreign-going ships the lifeboats are to be transferable to either side.

Davits to have gearing to turn the boat out even against a considerable list. To have non-toppling blocks or two sets of falls if they deal with more than one boat, and wire falls with lowering drum and brake if with more than two boats.

Motor boats to be optional; in any case, not more than two will be necessary on each side of the vessel, their radius of action to be 100 miles on kerosene (paraffin) fuel.

It remains to be seen how soon, and to what extent, these recommendations will be embodied in statutory rules, but there can be no doubt that they would have an important effect upon the problem of boat accommodation and stowage. The committee has done much painstaking work in testing the stability of open lifeboats, decked lifeboats, deck seats, and rafts. Much light has been thrown upon a subject hitherto greatly neglected, and the results of their labors will undoubtedly be to encourage the development of more reliable and stable forms of all such appliances.

But when all has been said and done, I think it is certain that in the future, as in the past, safety of life at sea will depend more upon the avoidance of accident than upon its repair, and that careful navigation will prove of infinitely more value than the most minute subdivision or the most perfect equipment of life-saving appliances.

A Device to Facilitate the Coupling of Cruising Turbines*

BY HAROLD E. YARROW

Owing to the uneconomical performance of turbines when developing powers considerably below full power, attention has recently been directed to improving the economy of vessels when cruising at low speeds by the introduction of special motors, such as turbines, internal-combustion engines or reciprocating steam engines. Sir Charles Parsons has already constructed successfully turbine installations having special cruising turbines. Certain difficulties that arise from the use of an additional motor, transmitting its power simultaneously with the main turbine, may render it necessary to use the main turbine and the cruising turbine independently of one another, the vessel being driven by the one or the other, and not by the two in combination. This involves connecting and disconnecting the low-power motor from the main shaft.

motor out of gear by means of an ordinary well-designed clutch. It is, however, not such an easy matter to make the change from the full-power turbine to the low-power motor, because in this case the clutch has to be put into gear. This can be done by stopping the vessel, but that may not always be permissible, and if it can be avoided it is certainly preferable.

On account of the large powers now in use even when cruising, if the two shafts that it is desired to couple together are not rotating at nearly the same speed, it would not be possible to engage the clutch without involving an objectionable shock. On the other hand, if the clutch is put into gear when the shafts are revolving at approximately the same number of revolutions, it is evident no appreciable shock would be caused. It therefore becomes necessary to adopt some device by which the relative speeds of the two shafts can be ascertained; and when they are revolving at practically similar speeds the clutch could be put into gear, and the shafts then connected together. Fig. 2 shows one arrangement proposed, from which

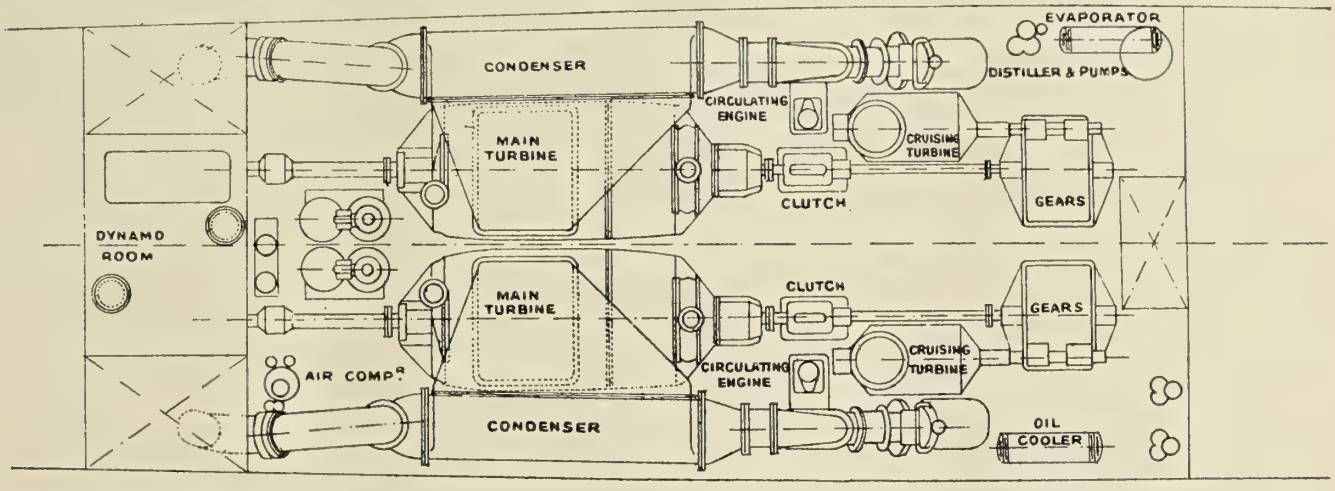


FIG. 1.—ARRANGEMENT OF MAIN TURBINES AND GEARED CRUISING TURBINES, WITH CLUTCHES FOR DISCONNECTING CRUISING TURBINES FOR FULL SPEED

The cruising turbine or engine may drive the main shaft through the medium of electrical or hydraulic transmission, or by simply throwing in and out of gear a clutch; the latter arrangement undoubtedly offers advantages, there being no appreciable loss of power, and the increased complication and cost of an electrical or hydraulic transmission are avoided. The use of a friction clutch on board ship may lead to difficulties, especially in view of the comparatively large powers that have to be transmitted. The simpler and more direct method is by throwing in and out of gear a dog clutch, so that the cruising motor can be coupled up or not as desired. This paper is not intended to deal with the design of a suitable dog clutch, but it has been prepared with a view to submitting to the meeting devices which will facilitate the coupling of the clutches.

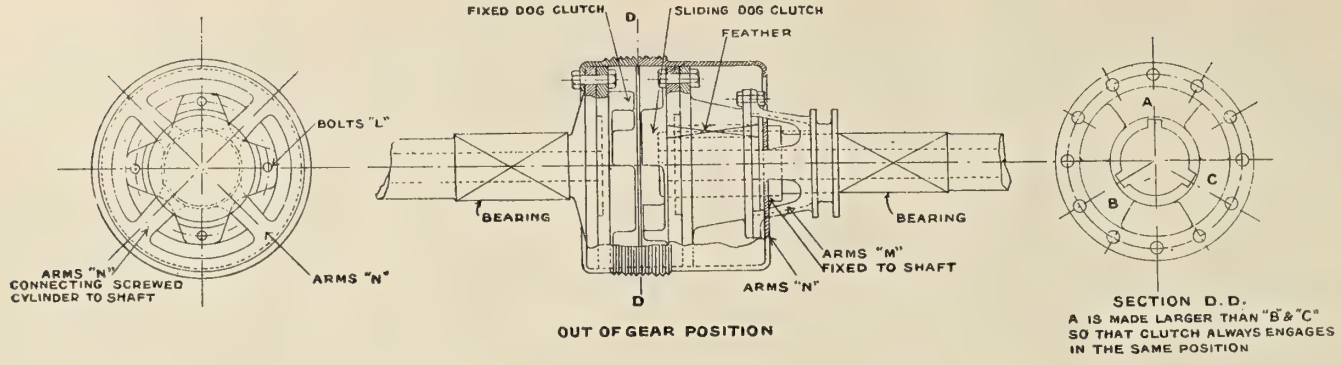
When a high speed is demanded it is contemplated that the main turbine only will be working, and when a cruising speed is required the cruising motor only will be working, the main turbine in this case being simply driven round by the cruising motor. If the cruising motor consists of a steam turbine, the exhaust from it could, of course, be utilized in the main turbines to assist in the propulsion of the vessel. Fig. 1 represents one arrangement of turbine machinery.

Assuming that a vessel is being propelled at low speed by means of the cruising motor, which would probably convey its power to the main shaft through gearing, and it is desired to increase the speed and propel the vessel by the main turbine, no serious difficulty would be found in throwing the cruising

it will be seen that on the outside of each coupling a screw thread is cut, the threads on both couplings being similar. By watching the thread when the couplings revolve it makes their relative speeds at once apparent, and when the screw threads appear continuous the two couplings will be revolving at equal speeds. If they are rotating at different speeds the one which is revolving the more rapidly will make the screw thread appear to be traveling faster. The optical effect produced by the rotation of the clutches upon which the screw thread is cut makes the progression of the thread or spiral line in the direction of the axis of rotation readily apparent, the eye at once recognizing any difference in speed between the two shafts.

Fig. 3 shows another method of carrying out the same idea. It will be seen that two pulleys are driven from each of the two shafts that it is required to couple together, the pulleys revolving in opposite directions. Each pulley would be attached to a short spindle having at its extremity a bevel wheel gearing in with another bevel wheel, which latter would be fixed in a revolving frame, and therefore forming a differential gear similar to that used in a motor car. If the two shafts are revolving at the same speed it is evident that the revolving frame will remain stationary, but if there is a difference in the revolutions of the two shafts the difference will make itself apparent by causing the revolving frame to rotate either in the one direction or the other, depending upon which shaft is traveling faster. On the outside of the revolving frame it will be seen a screw thread is cut so as to make apparent the speed and direction of rotation of the revolving frame. When the speed of the two shafts approximates very closely, the revolving frame will almost stop, and the coupling can be connected with the minimum shock.

* Abstract of a paper read before the Institution of Naval Architects, Glasgow, June, 1913.



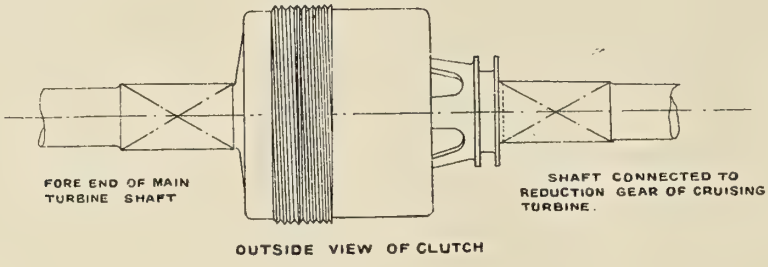


FIG. 2

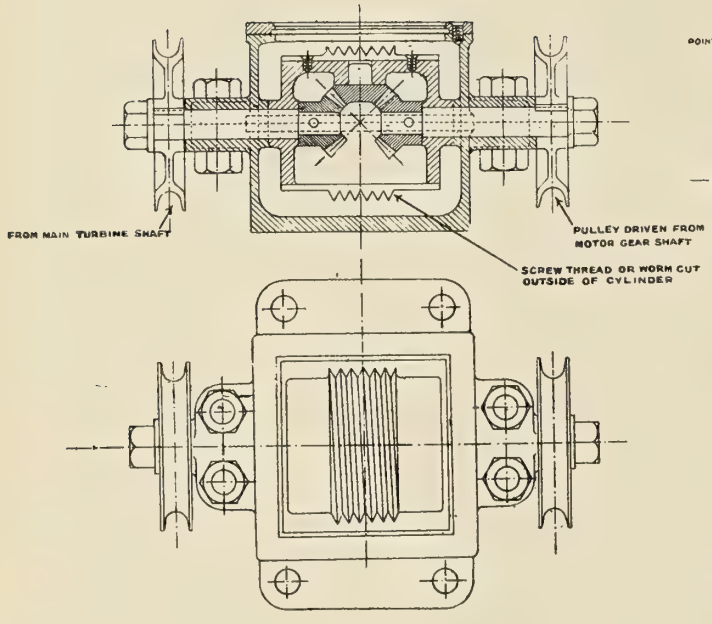


FIG. 3

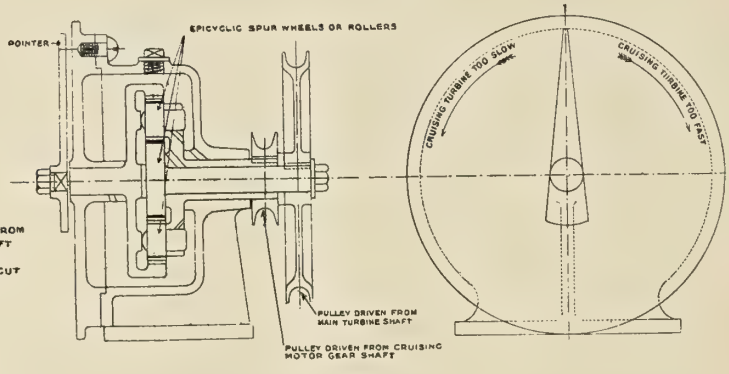

POINTER
EPICYCLIC SPUR WHEELS OR ROLLERS
CRUISING TURBINE TOO SLOW
CRUISING TURBINE TOO FAST
PULLEY DRIVEN FROM MAIN TURBINE SHAFT
PULLEY DRIVEN FROM CRUISING MOTOR GEAR SHAFT

FIG. 4

Fig. 4 represents another device by which a pointer indicates the relative speeds of the two shafts.

Many other devices could be designed for effecting the same object, but it will be admitted that without some means of this kind it would be very difficult to form a correct estimate of the speed of rotation of the two shafts in line with one another.

Although such a device has not been fitted by us in any vessels, from trials made in our shops it has been found very easy to determine the proper moment to engage the clutch.

With reference to the coupling itself, in which an ordinary dog clutch is used, it is desirable that the two clutches should only be capable of being put into gear, so that the same faces are always in contact with one another, because with the greatest possible accuracy in workmanship it may be found that the work will not be taken up equally by the different surfaces in contact, and the faces of the clutch will readily wear. Therefore, it is submitted that whatever clutch is adopted the same faces should always be in contact, and this can be effected by the projections of the dog clutch being of unequal size.

Another point which should be borne in mind in connection with such clutches is to design the bearings which support the shafts close up to the clutches, so that they should not be subjected to unequal wear. This is necessary, because if there is a difference in the amount of wear to which the two bearings are subjected, causing the shafts to get out of line, the want of alinement thus arising between the two clutches will cause movement between them and lead to trouble. For this reason it may be desirable that a certain length of shaft should be interposed between where the power is transmitted and the clutch, which would allow for the unequal wear of the main engine or turbine bearings; while the special bearings which have only to support the weight of the shaft near the clutches may be considered as likely to wear evenly.

MONTHLY SHIPBUILDING RETURNS.—The Bureau of Navigation reports 132 sailing, steam and unrigged vessels of 38,207 gross tons built in the United States and officially numbered during the month of July. Eight of these vessels were steel steamships aggregating 26,633 gross tons, of which four, totaling 15,655 gross tons, were built on the Atlantic Coast; three, aggregating 9,400 gross tons, on the Great Lakes, and one, of 1,578 gross tons, on the Pacific Coast.

Laying Out Propellers*

In the following article is explained a method of laying out propellers which the writer has used at the works of the Trondhjems mekaniske Vaerksted for the last six years. The method has been found very satisfactory, both in the drawing office and in the foundry. Of course any method for developing a screw-thread surface on a plane surface is inexact, but the method explained has been found sufficiently accurate for all practical requirements. Figs. 1 to 3 show the method of laying out the propeller in the drafting-room; Fig. 4 shows an adjustable guide-curve device used for molding propellers; while Fig. 5 shows the details of this device. The guide-curve device has been in use at the works mentioned for the last two years, and has proved very satisfactory as a saver of both time and material. The halftone shows a model guide-curve device, 9 inches long, placed beside a wooden model, which represents the propeller mold, and which is marked off from the propeller drawing. Fig. 5 gives the main dimensions for a full-sized device in use in the works. The guide-curve can be adjusted, ready for use, in from 10 to 15 minutes.

The method of laying out the propellers and the use of the guide-curve device can be best explained by reference to a specific example. The dimensions of the propeller to be laid out are supposed to be known. In this case, the diameter is 14 feet, the pitch is 16 feet 6 inches, and the area of the developed surface of the blade 61 square feet. The back-throw abaft the propeller hub is 6 inches.

In the plan, as shown in Fig. 1, first draw a section of the blade and the hub; then draw an arc of a circle *G*, passing through the tip of the blade. Mark off on the radius *OG* any number of points *A*, *B*, *C*, etc., and draw arcs through these points with *O* as a center. On arc *G* set off any number of equal distances 1, 2, 3, etc., and 1′, 2′, 3′, etc., on each side of the center line *OH*, and draw radial lines from the points thus set off. In the present case each of the divisions on arc *G* is 6 inches.

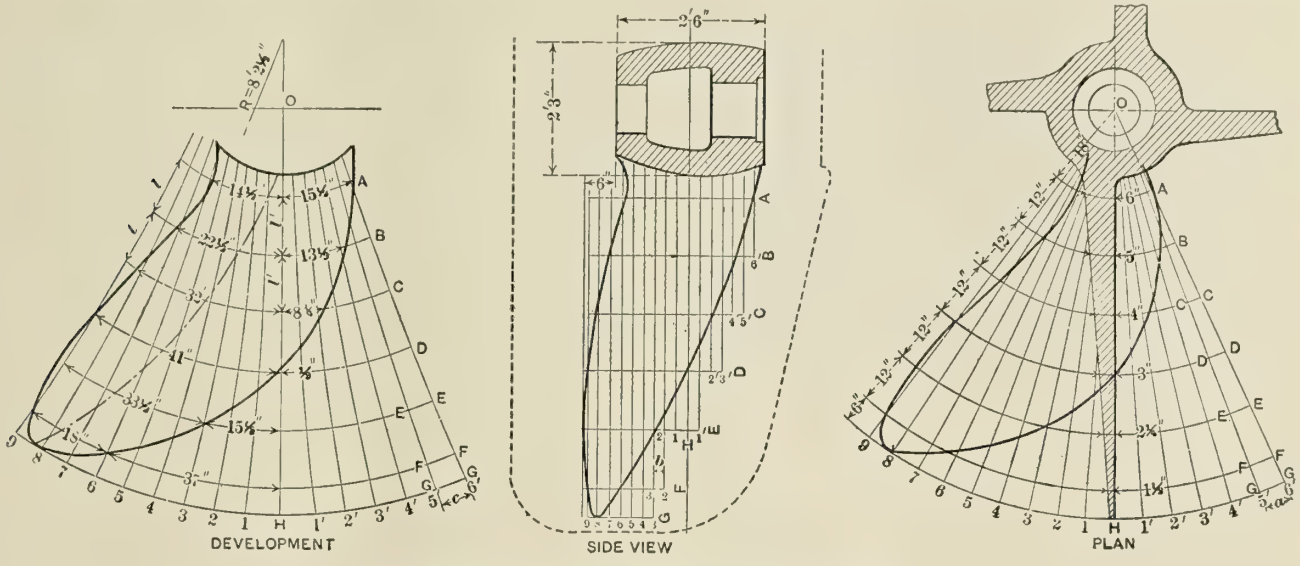


FIG. 1.—DEVELOPMENT, SIDE VIEW AND PLAN OF PROPELLER

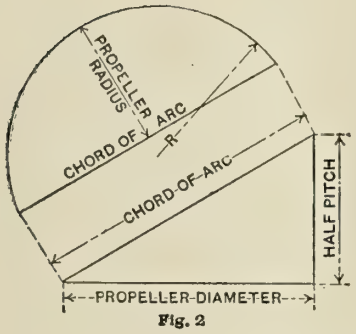
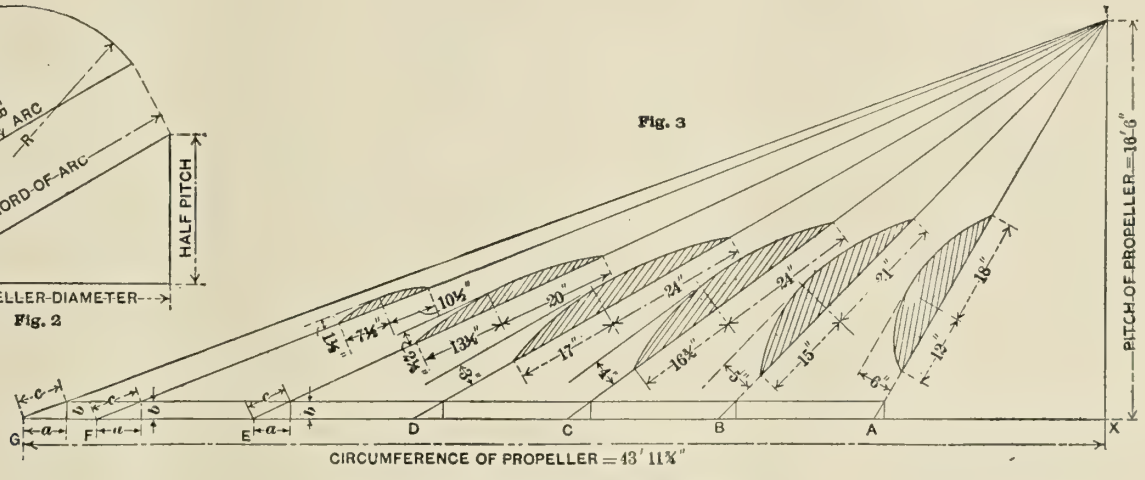


Fig. 2

Fig. 3



FIGS. 2 AND 3.—METHOD OF LAYING OUT PROPELLERS

Lay off to any convenient scale the horizontal line *GX*, Fig. 3, which represents the circumference of the propeller at the tips of the blades, and let the distances *AX*, *BX*, *CX*, etc, represent the circumference at points *A*, *B*, *C*, etc., in the plan, Fig. 1. The vertical line *XY*, Fig. 3, represents the pitch of the propeller. Join the points *A*, *B*, *C*, etc., with the point *Y*, as shown. These lines show the angle of the propeller blade sections. In the side view, Fig. 1, draw the longitudinal section of the propeller hub and the propeller aperture. The hub must be placed in its proper position in the aperture so that the exact clearance of the propeller can be seen. The aperture is indicated by dotted lines. Also divide the space for the side view of the blade, by vertical lines, into a number

* From *Machinery*.

of equal spaces corresponding in number to the divisions in the plan.

Set off on the base line at *G*, Fig. 3, any one of the distances on arc *G*, Fig. 1. In the present case, assume that the distance *a* in the plan is transferred as indicated. Distances *b*, Fig. 3, are equal to any of the distances *H*-1, 1-2, 2-3, etc., in

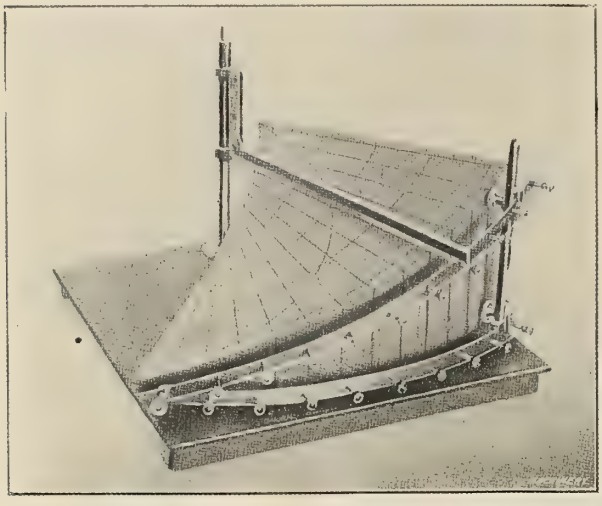


FIG. 4.—MODEL OF GUIDE-CURVE DEVICE FOR MOLDING PROPELLERS

the side view. As the propeller has a uniform pitch, the height *b* will be the same for all the small triangles shown at the base in Fig. 3. The base *a* of the seven small triangles, however, is equal to the distances *FF, EE, DD,* etc., on the arcs *F, E, D,* etc., in the plan view. The hypotenuse *c* in each of the small triangles is now equal to the distances *GG, FF, EE,* etc., in the development in Fig. 1.

Next calculate the radius of arc *G* in the development. As is well known, the radius in the development view will not be the same for two propellers of equal diameters if they do not have the same pitch. The easiest way to determine this radius is as follows: Draw a triangle, as shown in Fig. 2, where the base equals the diameter of the propeller, and the height equals one-half the pitch. The hypotenuse of this triangle will then be equal to the chord of an arc, the versed sine of which equals the radius of the propeller, and the radius of which equals the radius of arc *G* in the development.

The formulas for the calculation of the radius *G* of the development are as follows (see Fig. 2):

Let C = chord of arc,
D = diameter of propeller,
P = pitch of propeller,
R = radius of development of propeller blade surface,
Then

$$C = \sqrt{D^2 + (\tfrac{1}{2} P)^2}$$

$$R = \frac{(\tfrac{1}{2} C)^2 + (\tfrac{1}{2} D)^2}{D}$$

The radii for arcs *A, B, C,* etc., in the development, Fig. 1, are determined in a similar manner. In the development, the same center can be used for all seven arcs if the pitch is small, but for large pitches it is necessary to move the center upwards for the smaller arcs, otherwise the distances 1 will be somewhat longer than distances 1′, as the lines in the development are not radial. Set off a sufficient number of distances 1, 2, 3, etc., and 1′, 2′, 3′, etc., on both sides of the center line *OH* in the development. Set off on the arcs *A, B, C,* etc., the distances *c* as found from Fig. 3, *c* being the hypotenuse of the seven small triangles, as already explained. Through the points thus determined draw slightly curved lines which represent the radial lines in the plan and the vertical lines in the side view. Then, in the development sketch in, by free hand, the propeller blade to about the required shape, and measure the area by a planimeter. Small alterations may have to be made in order to get the right area.

On the radial lines in the plan and the vertical lines in the side view mark off the points where the contour of the blade crosses the radial lines in the development, and then, by free hand, sketch in the contour of the blade through these points, so as to get the shape of the blade in the plan and side view. It must be remembered that the shape of the blade in the side view is not what it would appear to the eye, but is the exact opening required for the blade when revolving. The curve of the propeller hub in the development is found by taking the vertical distances between the horizontal line *A* and the propeller hub in the side view.

The use of the guide-curve for laying out propeller blades in the foundry from the drawings will be apparent from the illustration of the device itself.

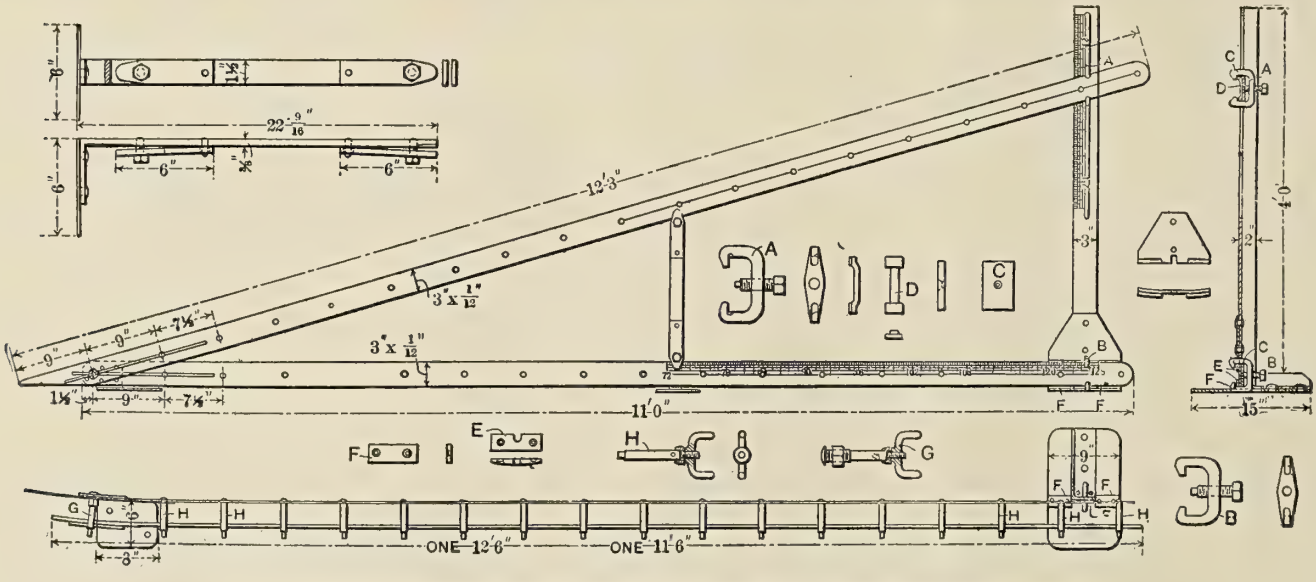


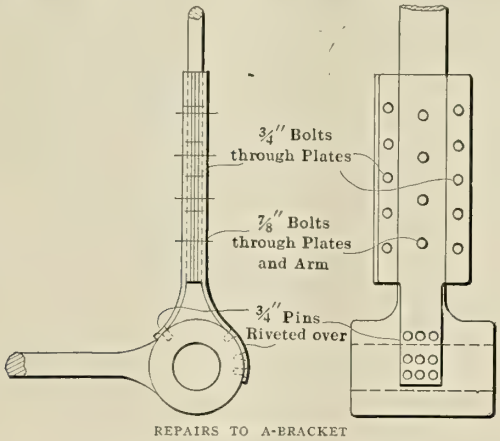
FIG. 5.—DETAILS OF FULL-SIZE DEVICE MADE ON SAME PRINCIPLE AS THAT ILLUSTRATED IN FIG. 4

Letters from Practical Marine Engineers

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs

Repair to a Damaged A Bracket of a Turbine Steamer

One of the A brackets which support the outboard propeller wing shaft of the turbine steamer *A*——— had struck an obstruction and cracked at a point near the boss. The following repair was effected: Two pieces of ½-inch plate were obtained and cut and bent to suit the shape of the arm and boss as shown. These were beveled off on the ahead side with a hammer and chisel. Holes were drilled in the plate as shown



REPAIRS TO A-BRACKET

and the plates fitted in position and holes bored in the boss and arm to suit. The holes in the boss were tapped ¾ inch Whitworth thread; and the corresponding holes in the plate being countersunk, ¾-inch screwed wire was screwed in and riveted over. The holes in the arm were made clearing holes to take ⅞-inch diameter bolts. This temporary repair answered very well until the steamer was brought up for a thorough overhaul, when it was removed in good condition.

Glasgow. "ISON."

Bearing Pressure on Guide of Paddle Engines

A skeleton drawing of the side elevation of an ordinary diagonal engine, such as is commonly used in paddle steamers, is shown. The engine is usually placed in the ship with the cylinders furthest aft, as shown, the direction of revolution for going ahead being, of course, as indicated by the arrow. Consider the case of the engine going ahead, the crank and the connecting rod being in the position indicated by the full lines *O C* and *P C*.

The piston is being urged forward by the steam, and hence the piston rod and also the connecting rod are in compression, the thrust on the connecting rod being in the direction *P C*. Obviously the direction of the thrust on the guides is downward, viz., *R P*.

Next imagine that the crank has traveled round to the position indicated by the dotted lines *O C′* and *P C′*, the engine going ahead as in the previous case. In this instance the piston is being pulled back, hence the piston and connecting rod are in tension instead of in compression, as in the previous case, and the pressure on the guides is still in the same direction—namely, *R P*—and not, as some people imagine, in the opposite direction. It may be momentarily in the opposite direction, due to the wheels carrying the engine over the dead center, and hence placing the connecting rod and piston rod in tension for a small fraction of the return stroke, but the main point is that the pressure is chiefly in one direction for a certain direction of rotation of the engine.

The explanation of this may not seem quite clear when set down on paper, but a simple experiment performed with a pair of hinged rods will illustrate the direction of pressure to those who do not at first quite grasp the explanation. It may be noticed, by the way, that in screw engines one guide surface is usually much smaller than the other, the smaller being the astern surface, and as the engine seldom goes astern for long this can afford to be made smaller, whereas if the pressure alternated equally between the two surfaces these surfaces would naturally have to have the same area.

It was suggested to me some time ago that if paddle engines were placed in the ship in the opposite direction—that is, with the cylinders farthest forward—the loss of power due to friction on the guide surfaces would be materially reduced. With the engine placed in the ship with cylinders farthest forward, the direction of rotation for going ahead will be opposite to that indicated by the arrow in the sketch. The case is similar to that of the engine in the sketch going astern.

In the first instance which we considered the pressure on the guides for going ahead is equal to the load due to the steam

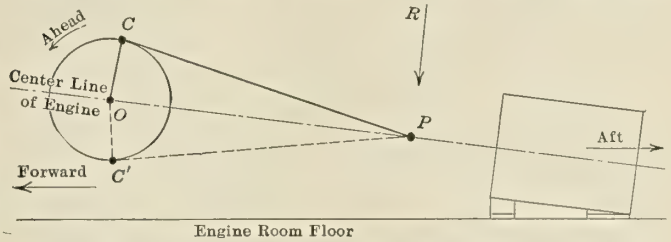


DIAGRAM SHOWING BEARING PRESSURE ON GUIDE OF PADDLE ENGINE

plus the weight of the crossheads, connecting rods, etc., while in going astern the total bearing pressure is reduced by the load due to the weight of these parts. Hence it will be seen that in Case II the bearing pressure on the guides for going ahead is less than that of Case I. If this weight of the crossheads and connecting rods is considerable, the method of placing the engine in the second case—namely, cylinders farthest forward—should result in a decrease of power lost due to friction on guides. It may be possible that there are objections to this method or that the decrease in lost power is not so great as it may seem, which would account for the fact that paddle engines are not, so far as the writer is aware, placed in the ship, as in the manner suggested in the second case. "M."

Glasgow.

An Indicating Curiosity

Indicating a steam engine presents some pretty possibilities; extraordinary results can frequently be attributed to faulty rigging up, stretch of cord, friction of indicator piston, length of connecting pipes and condensation, all of which play their part in rendering the results obtained inaccurate.

A good, practical engineer, otherwise normal and sane, was puzzled for a long time as to the reason he failed to get boiler pressure as the initial pressure in the high-pressure cylinder.

Twenty or thirty feet of steam pipe, even if covered adequately, always results in an appreciable drop in pressure, as shown by the indicator diagram. After this idiosyncrasy of his was known, his juniors used to shift the atmospheric line to make a peaceable engine room.

A point in connection with indicating seems of some moment. This concerns the vertical admission line of the diagram. This is usually cited as proof of the instantaneous rise in pressure in the cylinder as soon as the valve opens to steam. When considering the actual application of the indicator, one is less sure about this instantaneous rise in pressure. It is obvious that the valve takes time to open, while the admission line is square or nearly so to the atmospheric line.

Consider for a moment, however, the usual attachment of the reciprocating cord to the indicator drum. The piston has its maximum velocity at the center of its stroke, while, when passing the dead center, there is no lateral movement to the piston. The attachment of the cord to the crosshead by means of reducing lever gives two dead points to the movement of the indicator drum; one of these is coincident with the admission line of the diagram.

The movement of the diagram paper past the pencil is therefore greatest at the center of the expansion line and least at the ends of the stroke. As a consequence, a bad admission line is a rarity in a diagram, and when found means considerable fault with the setting of the slide valve. Want of coincident line between the edge of the steam port and the edge of the valve is not under these conditions made apparent.

It should be possible to meet the case by the use of two coupled drums revolving steadily by mechanism resembling the works of an ordinary clock. The diagram obtained would then be a series of waves, to some extent similar to the turning effort diagram of a crank. This would give an analysis of the admission line of the diagram not possible under the ordinary indicator method, the drum in the latter case remaining stationary when the admission line is formed by the indicator pencil.

A result similar in effect can be obtained in a compound engine by obtaining the indicator-drum motion from the other crosshead; such diagrams are puzzling at first sight, but it is obvious that admission is not an instantaneous rise. Of course, mean effective pressure cannot be calculated either with the suggested method of two drums or with crossed cords.

A curiosity never previously commented upon, to the writer's knowledge, was brought under notice recently.

A steam engine, running under a brake using a constant load, varies in horsepower directly as the revolutions. Double the revolutions, and the effect is to double the horsepower. It is surprising, using an integrating counter reading directly as revolutions per minute, the difference 5 pounds' variation in steam pressure has upon the revolutions. As a matter of fact, the difference between 155 and 160 pounds has an effect upon revolutions quite in excess as a proportionate increase. In effective result in a steam plant, it is the last 5 pounds which counts, and the closer steam can be kept to the maximum limit of blow off, the greater the enonomy of the job. Careful attention to full steam has a marked effect upon coal consumption.

The curiosity is this: Take any slide valve engine, having link reversing gear, and place same under friction diagram conditions. The steam entering the cylinder then simply serves to overcome the friction losses of the engine. When steady conditions have been obtained with regard to revolutions, now link up the valve gear, and it will be found that the revolutions of the engine increase 10 percent. This increase in revolutions is most marked when the engine with gear full out is just turning over the centers.

The explanation is simple: The steam entering the cylinder is very small in amount, and linking up has no effect upon so small a quantity. The greatest internal loss in the engine is the friction of the slide valve; by linking up, the travel of the valve is shortened, hence the increase in revolutions.

London. A. L. HAAS.

The Care of the Dynamo on Board Ship

Electricity for use in lighting and for auxiliary power purposes is now becoming so increasingly popular in connection with the mercantile marine that it becomes part of the duty of every marine engineer at one time or another to handle the ship's dynamo. So far as the mechanical part of the work is concerned, every man worth his salt will know the difficulties which arise, and it is not intended to say very much about this part of the subject in these notes. Electricity, however, is a rather curious and sometimes a dangerous thing to handle, unless those in charge of it know exactly how to carry out the necessary work in connection with it, and for this reason it has been thought advisable to write one or two notes about the way in which the main dynamo should be handled, more especially from the point of view of the way in which any difficulties in its running should be cured.

In the present set of notes only one point will be dealt with, and that is the difficulty that very frequently occurs owing to the brushes sparking while the dynamo set is running. This may be due to a number of causes, and it is necessary in order to get the matter put straight that these causes should be properly understood. One of the most frequent causes of sparking of the brushes is due to a dirty condition either of the brushes or of the commutator (by which is meant the revolving set of bars on which the brushes rest in order to collect the current from the armature), or both. Dirt is as great an enemy to successful work with electrical apparatus as it is with mechanical. Even a beginner in mechanical matters knows the importance of keeping dirt out of the bearings, and it is equally important to keep dirt off the commutator. Where, as in an engine room, flying dirt is frequently of an oily nature, this oily deposit is liable to form a film on the commutator, and under the action of the heat from the armature it becomes a hard deposit. An electrical engineer should therefore early learn how to distinguish the clean, bluish purple skin formed on the commutator by successful running, and the black, opaque, grimy deposit formed of carbon dust or other dirty matter combined with oil caked onto the commutator, and giving a very good chance for the electric current to bridge across from one brush to another and so cause a breakdown. The brushes also should be very carefully examined from time to time to see whether their surfaces are in good condition, as upon examination of this sort very largely depends the treatment which has to be given to the brushes, brush gear and commutator.

The time is, of course, gone by when the marine engineer finds himself under the necessity of lubricating the commutator with an oil can at the same time as he is attending to the bearings, although cases have been known where misguided juniors have thought that the commutator is best served by lubricating it occasionally. This is a mistake. If the commutator shows signs of harsh running, evidenced by a squeaking noise, the only lubrication to be given is the slightest touch of pure vaseline, applied very sparingly with a soft rag. Anything more than this is detrimental both to the commutator and the brushes. If in the first instance the commutator appears to be dirty, the best way to get it into good condition is to lift the brushes, and then to take a rag, not too freely saturated with the kerosene (paraffin), and cleanse the surface of the commutator from the oily deposit which it may have. If there is nothing more wrong with the commutator than dirt it will probably be found that the machine will run satisfactorily.

Examination of the brushes will always be a useful thing. Nowadays modern dynamos are almost universally provided

with carbon brushes, the old copper wire gauze brush having gone out of fashion, and with it a large amount of sparking. On taking the carbons out from the holders it may be found that these have accumulations of oily and dirty matter on them. These should, of course, be carefully cleaned off. On looking at the end of the carbon brush where it presses on the commutator, there may be signs that it has only been rubbing over part of its surface. It is easily seen by inspection which part has touched and which has not, and instructions will be given in a few paragraphs as to how to bed the brush down properly. It may be said here, however, that bad bearing of the brushes on the commutator is a very fruitful source of sparking. It may also be noticed that on the front edge of the brush there are signs of burning or metal deposit on it. This means that violent sparking has at some time or another been occurring, and must be put right. All these indications are of considerable value to the experienced electrician in deciding him as to what to do in order to cure sparking troubles.

Dealing first of all with the more ordinary troubles in the commutator causing sparking, many a commutator has been ruined because the engineer has not taken the matter in time and prevented a small trouble from developing into a large one. Supposing that after cleaning up with kerosene (paraffin) in the way described above, and setting the machine to work, the brushes being properly adjusted as described below, the commutator still continues to spark, it is very probable that one of the copper bars is perhaps of softer metal than the others, and the heating and rubbing of the brushes upon its surface has worn that bar down quicker than the others close to it, with the result that every time that particular bar passes under the brush a spark occurs. Then this spark itself causes the copper to melt and form copper vapor, and thus the process goes on at a still more rapid rate. The best way to get over this is to note whether any particular bars seem pitted or corroded while the others are in good condition. When this is the case a block of wood should be taken and cut out to the same curve as the circumference of the commutator. A sheet of very fine glass paper should then be placed, sand side out, in the curve of the block of wood, and while the dynamo engine is run with the brushes lifted this should be pressed lightly but firmly on the surface of the commutator. The glass paper will take a slight skim off the high bars, and finally the whole surface of the commutator will be brought up to a true cylinder. This will give a soft commutator bar a fresh start, and providing that it is properly attended to afterwards it is very likely that the trouble will not happen again. Of course, there are troubles in the armature and armature connections which may interfere with the proper working of the commutator bars, but these will have to be dealt with later.

Another thing which sometimes causes bad sparking is that the mica strips which are inserted between the bars of the commutator may be of harder substance than the copper itself, and when the commutator is running these strips are more durable than the copper. In this way a lot of small ridges are formed around the commutator, and the copper gradually wears down more quickly than the mica. The result of this is violent sparking all round the commutator, and the only way to get out of the trouble is to frequently clean down the commutator with glass paper in the way described above. It should be remembered that emery cloth is not to be used in place of glass paper, as there is danger of the emery giving rise to a flash-over. After the commutator has been cleaned in this way it should be carefully wiped down, and if there is a pair of small bellows handy any copper dust ground off the commutator should be blown out or else there may be trouble. When the brushes are again let down onto the commutator a slight touch of vaseline should be given as a lubricant.

Sparking trouble may, however, be caused not by the condition of the commutator itself, but by the condition of the brushes, or the way that they are applied to the commutator. It is very often found that the material of the brush itself is not quite suited for the work it has to do, and if after trying the remedies described below the sparking does not improve, it is advisable to try a change of carbon brush of either a softer or harder variety, according to circumstances. It is important that the material of the brush should be as uniform as ever possible, as a single hard portion in the brush may cause quite a lot of scoring and sparking. Examination of the brush end will sometimes show a hard patch of this sort, and it is a very good plan to scrape this away carefully with a penknife and then re-bed the brush onto the commutator. The best way to bed brushes when they show that they are not sitting properly on the commutator, or if they have been cleaned and scraped, is to let them down onto the commutator in their normal position, previously having laid over the surface of the commutator a strip of fine glass paper with the glass side outwards. When the brushes are let down onto this, the strip should be drawn gently backwards and forwards, bearing down upon the surface of the commutator so as to keep the curve right. In this way the ends of the brushes will be cut to the shape of the commutator, and will then bed themselves accurately into position. Care should be taken after doing this to blow away all carbon dust in just the same way as the copper dust was removed from the commutator when it was cleaned, as carbon, like copper, is a conductor of electricity, and might give rise to serious short circuits.

If sparking is accompanied by chattering or squealing of the brushes it is very probable that there is something wrong with the tension of the springs, which bear the brushes down onto the commutator, and it is advisable to try regulating these. It is important that the pressure should be kept just sufficiently light to ensure a firm, gentle pressure. Anything like heavy bearing means that the brushes wear out rapidly, there is excessive friction and heating, and a streak of carbon dust deposits on the commutator, and before long a flash-over occurs owing to the thick accumulation of carbon. The holders should allow the brushes to slide fairly easily, so that there is no chance of the carbons sticking up out of contact with the commutator, but at the same time they should not be loose enough to allow the brushes to wriggle, as otherwise it is impossible to keep a good bearing surface. Put in other words, it is necessary that the brushes should be exactly of the proper size for their brush holders. Spring tension can always be adjusted, if the carbon brushes slide easily, to a very great degree of nicety. No definite rule can be given as to the exact pressure which should be placed on the brushes, as this varies with the exact quality of the brushes and the amount of work to be done. It is better, however, to err on the light side rather than to give heavy bearing. A good deal of trouble sometimes happens if the contact between the brush and its holder is bad, as the current finds it difficult to get across from the brush to the holder, and heats the brush up unduly. This heat is then communicated to the commutator, with the result that before long sparking and arcing take place, to the detriment of the dynamo.

Supposing that everything had been done as described above to secure good bedding, an even surface to the commutator, careful spring adjustment and good contact, and sparking still continues, it is now necessary to turn attention to the position of the brushes with relation to the commutator and the poles of the machine. First of all it may be said that on most dynamos the brush should be of just sufficient width to cover slightly over two segments or bars of the commutator unless the number of bars is very great indeed per pole of the machine, in which case it may be necessary to cover three bars. It is not useful, however, to cover too many bars of the commutator at once, because when the brush covers two adjacent bars current can flow from one bar through the winding connected to it, round the next bar and then through the brush

itself, completing its path and set up a local current which warms up the bars and windings uselessly. Too large brush width is not therefore advisable. At the same time the brush should not be made too narrow, because it is found that the current in a winding does not die down and reverse its direction instantaneously, but takes a little time in doing it, and this time is absorbed by the interval required to pass, say, two bars under the brush width. All this is a question of experiment, and the engineer who is confronted with a bad case of sparking should make tests for himself as to the right width of contact of the brushes with the commutator, always bearing in mind that in order to avoid overheating of the brush itself the area of contact must not be reduced unduly.

If the sparking appears to be about equal on all the sets of brushes around the commutator, it is very likely that while the dynamo has been running the brush rocker has become slightly displaced, and the brushes are therefore not in the best position for collecting the current. The best way of testing this is to rock the carrier backwards and forwards slightly while the dynamo is running under load and noting carefully whether the sparking increases or decreases as it is rocked. Care must be taken not to let the motion of the commutator drag the brushes forward too far, as otherwise a bad flash-over will occur owing to the dynamo loosing its exciting current. With care, however, it is easy to rock the brushes backwards and forwards until the point of least sparking is found. When this is done the rocker should be thoroughly and permanently clamped into this position. In some of the older dynamos it will be found that this position varies with the amount of current that the dynamo is giving out. At light load the position may be different by a ¼ inch or ½ inch round the circumference of the dynamo to that occupied when the dynamo is working on full load and overload, and therefore the main ammeter on the switchboard must be watched and the position of the brushes altered in accordance with it. The careless attendant will probably cause a good deal of damage by neglecting to rock the brushes in accordance with the load if the machine is of the type where such alteration is necessary. In more modern machines, however, this is not so important, as they are designed with stiffer fields, and where they are subjected to very heavy and sudden overloads auxiliary poles are put in the magnetic circuit, known as inter-poles, for the purpose of correcting the twisting or distortion of the magnetic field, which happens when a heavy load is put onto the dynamo. In the inter-pole dynamo this distortion is corrected automatically, and there is not the same necessity to rock the brushes.

It may be, however, that the sparking occurs principally on one or two sets of brushes, and in this case it is probable that this particular set of brushes is wrongly set with relation to the rest. In order to test this, the best way is to take a long strip of paper and pass it round the commutator. Then mark on the paper with a piece of pencil the position of the front edge of each of the sets of brushes. Then take the strip of paper out and with a foot rule measure the distance between each of the marks. If all of these are exactly equal it follows that the spacing of the brushes is equal round the commutator, but if there is any difference there is one set of brushes out with respect to the others, and before satisfactory sparkless running can be obtained this irregularity must be corrected. In cases where the brush holders are set on a slant and not radial, the irregularity is probably caused by unequal lengths of brushes, and the only way to get the thing right is to file down the brushes until the spacing is correct. It may, however, happen that the brush rocker itself is at fault, and the spacing must then be corrected by a mechanical alteration, which may in some cases be a very difficult matter.

All the above is written on the assumption that the dynamo has only been called upon to do its fair share of work. In many instances, however, a ship's dynamo has been badly overloaded, more especially in view of the fact that it has been placed in a hot engine room, where it was naturally prone to warm up considerably and develop sparking tendencies. Most dynamos have plates on them showing the number of amperes and the pressure in volts at which they are normally supposed to work, and when this is the case it is an easy matter to compare the amperes with the indication of the main switchboard ammeter. If it is found that the dynamo is consistently working at a larger amperage than its proper value, it is unfair to expect that it will do anything less but spark, and this should be taken as an indication that the work should be eased off as far as possible. Again, the temperature of the engine room may be so high that it is unfair for electrical machinery to be asked to stand it at all, and ventilation should, therefore, be effected. Sometimes, owing to overloads and overheating, the insulation of the armature has become charred and the solder in the connections between the windings and the commutator has run and melted. The very least that can happen then will be considerable sparking, and a ship should always carry a spare armature for the main dynamo in case of trouble of this sort. Finally, it is necessary, especially on machines that have very little clearance between the pole pieces and the armature, to see that the bearings are kept in good condition. If the armature is allowed to drop with relation to the field, the magnetism upon which the generation of the electric current depends becomes distorted from its usual symmetrical distribution around the armature, with the result that one part of the armature may be trying to develop a great deal more current than the other half. The inevitable result of this will be sparking, which cannot be cured until the armature is restored to its central position with respect to the fields.

The above notes cover a few of the more important and likely causes for sparking in the main dynamo, and it is hoped that they will be of use to marine men who have to handle an electrical installation on board ship. A great deal more might be written on this and kindred subjects, but the limitations of space prevent too much detail being entered into at the present time. It may, however, be possible to return to the subject at a later date.

VICTOR WHITE.

London.

Steam Pipe Troubles

The material chosen for most steam pipes is still in many cases copper, although much has been written about the danger connected with the application of copper steam pipes with brazed flanges, and although many accidents show the necessity of departing somewhat from the common practice in this respect. No doubt copper was originally selected for steam pipes on account of its non-liability to corrosion and on account of its great ductility. It is often assumed that in bending pipes the axis of the saddle of the pipe does not lengthen, and that the material at the throat of the pipe becomes compressed to an amount about equal to the expansion on the back of the bend. This is not the case. As a matter of fact, the compression of the material is not very great, and the pipe expands by bending not only at the back of the bend but also on the sides, and, if it is remembered that the thinning of the metal must be proportional to the extension, it will be found that a pipe which has to be bent should be at least one gage thicker than required for the allowable pressure, and in many cases this is scarcely sufficient. Often the larger steam pipes are bound around with wire, while some firms put iron bands around the pipes every few inches. Such practices show that many engineers look upon copper with a certain amount of distrust.

When main steam pipes have to be made of copper, they should always be fitted with an automatic stop valve on the

boiler, which will shut off the flow of steam to the engines if the pipe bursts. There are many such stop valves which are not entirely trustworthy, but some good ones are obtainable. A boiler explosion will always be realized as a serious matter, and therefore the dimensions of the safety valve are controlled by law. But why does not the law also require the application of automatic stop valves when copper steam pipes are applied?

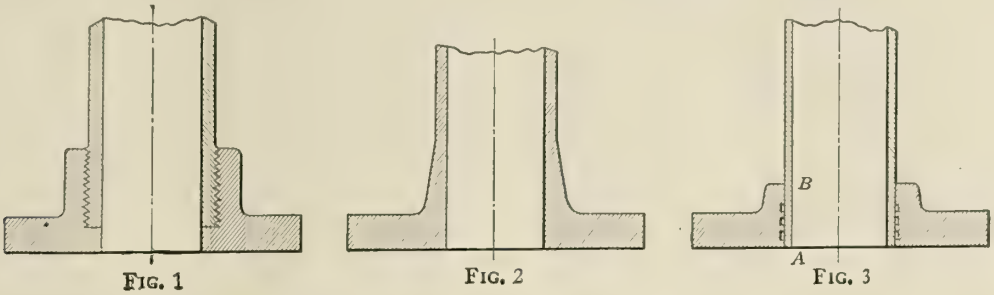


FIG. 1 FIG. 2 FIG. 3

FLANGES FOR STEAM PIPES

No doubt more men are killed by the bursting of copper pipes than by actual boiler explosions.

Brazed flanges are seldom trustworthy; the working of the pipes causes the spelter to become brittle, so that they will crack in the flange. For larger steam pipes the flanges are riveted to the pipes, which is a good practice, but the joint should be diagonal and not chain riveted, as with the latter method too much material in the pipe is drilled away, and the strength of the pipe is too much diminished. In fact, this has frequently been the cause of fractured pipes.

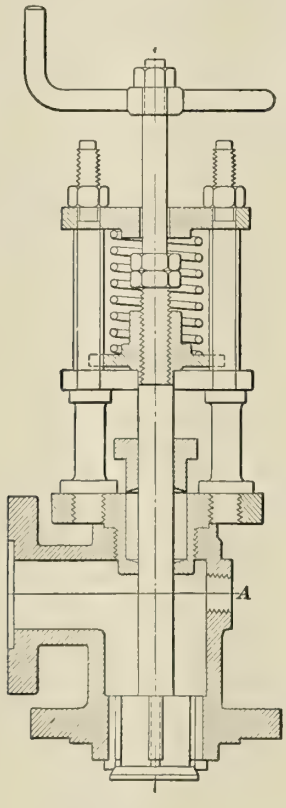


FIG. 4

Steel is often used for steam pipes, and in such cases the flanges are threaded on the pipes, as shown in Fig. 1, or the whole pipe is made from the solid shaft, as shown in Fig. 2. In the latter case the hole is often bored eccentrically to provide for the bends. Steel is much stronger than copper for withstanding the pressure. Its thickness is more equal than that of cold-drawn copper pipes. Its strength is not diminished by the steam pressure, and its coefficient of expansion is less, but this latter property does not allow smaller bends, as the steel is much stiffer than copper, so that the flanges of the valves must be very strong, and especially well ribbed to the body and fastened with strong bolts. For long pipes the application of stuffing-boxes for expansion is necessary, but this is also the case with copper steam pipes. Steel pipes are often expanded in the steel flanges in the same manner as boiler tubes are expanded in the tube plates. Grooves are turned in the flange, as indicated in Fig. 3, and the hole at *A* is bored about 3/32 inch wider than at *B*. This manner of flange attachment is very efficient.

Copper pipes are also expanded in the steel flanges, and for circulating, waste and other water services cast iron flanges are used.

In one case on board a steamship the main steam pipes had to be made of copper, as no other material was allowed. As the engine builders had had several accidents with copper pipes they considered it necessary to place on each of the two boilers an automatic stop valve, as shown in Fig. 4. The valve was especially constructed for this case, as shown in the illustration. At *A* a small pipe 1 inch diameter is connected, leading steam from a small valve on the boiler. This is first opened, and by this means the engine is warmed up. When the pressure in the pipe is the same as that in the boiler the main valve is opened and the small one shut. When steam is on and the engine is running it is impossible for the spindle to become burned in the stuffing-box, as the valve and the spindle are always moving up and down a small amount. The spring must be so regulated as not to close when the engine is racing. Should the steam pipe burst the velocity of the steam will be

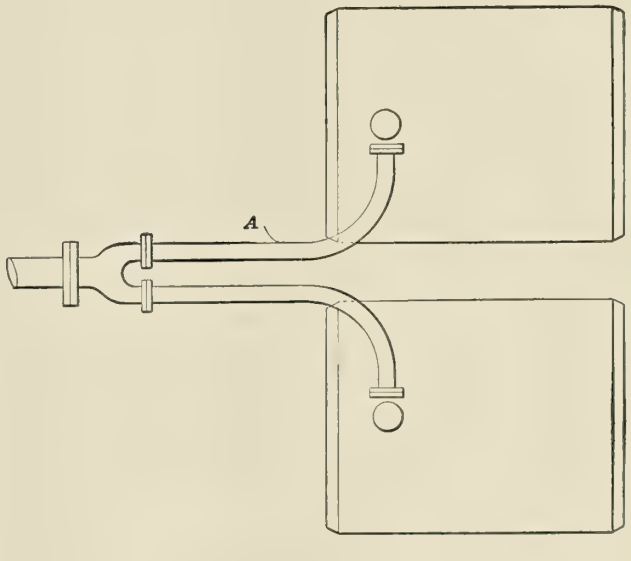


FIG. 5

so great that the pressure in the pipe will be less than the boiler pressure, so that the valve closes immediately. The steam pipes of this engine were expanded in the steel flanges, which at the beginning were perfectly steam-tight, but after a time they became so leaky that they had to be altered. The pipes were taken off and steel rings hammered into the pipe. These steel rings were then expanded in the pipe and the pipe was put back into place again. Since that time they have given no further trouble.

Some time later one of the pipes from the boiler burst, and the engine stopped. The engineer found in pipe *A*, Fig. 5, a burst seam 4 inches long. The automatic stop valves had performed their duty perfectly, and no doubt had saved the lives of the men in the engine room and stokehold. From this time on the engineers and firemen who had at first considered the valves as superfluous and troublesome were very anxious, and took special care to keep them in good order. They were not

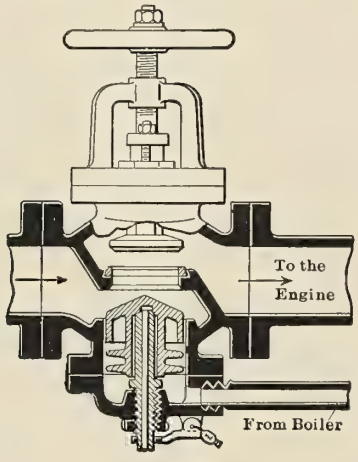


FIG. 6

very good automatic stop valves, but better ones are on the market, as, for instance, the one shown in Fig. 6. In this valve the steam flows in the direction of the arrow. When a steam pipe bursts the piece, *A*, will rise, forced up by the great velocity of the steam, and the pressure will be less on top of this piece than on the under side. The hole in the piece *A*, which leads to the atmosphere, allows the piece to be held down. The piece *A* may be put in place again by means of a lever and hand-wheel on the outside.

In any case, where copper steam pipes are used, an automatic stop valve is necessary, and it is unwise to do without them. It makes little difference what material is used for the steam pipe, an automatic stop valve is not out of place, and frequently where least expected it will save both lives and property.—D. K. in *The Boiler Maker*.

Graphite in Boilers

On one of the largest steamship lines operating from New York boiler graphite had been used for some time with very good results, until some one persuaded the engineers on one of the vessels to remove the zinc plates from the boilers on one particular trip. As soon as this vessel came into port, after a six months' trip, the boilers were found to be in very bad shape on account of serious pitting and corrosion. Previous to this trip the use of graphite in connection with the zinc plates had been found very satisfactory, as might be expected, because the zinc plates would offset any galvanic action which might be set up in the water used on these sea-going steamships, and also because the graphite would protect the boiler plates by dislodging any scale which might be deposited on them.

At the end of this particular trip the engineers were naturally at a loss to understand whether the excessive pitting and corrosion was due in any way to the use of graphite in the boilers, but investigations by experts seem to indicate that galvanic action was the cause of corrosion rather than graphite, as tests have shown that the presence of ten times as much graphite as is ordinarily used in boilers causes no unexpected increase in the rate of corrosion. In general, however, the manufacturers of boiler graphite recommend the use of either zinc plates or soda in boilers with the graphite to offset any tendency to corrosion.

Most engineers realize that the action of graphite in a boiler is not chemical but purely mechanical. Its use to overcome the danger and losses from scale formation is effective not because the graphite dissolves the scale or attacks the metal, but because the particles of graphite simply work into the minute cracks existing in any scale which has formed, and thus gradually penetrate between the scale and the metal, so that the scale is loosened from the metal and may be removed from the boiler with little trouble. Once old scale is removed from the boiler, the continued use of graphite means that it will be intermixed with any new scale which forms, rendering it soft and easily swept out instead of forming a hard scale on the metal. In other words, the boiler graphite forms a thin, slippery film over the boiler plates, protecting them from the action of the acids in the water and associates itself with the sediment which is formed, thus preventing the formation of hard scale and keeping the solid residue thrown down by the evaporation of the water in such a soft condition that it can be easily ejected from the boiler by blowing off.

It is sometimes the custom whenever the boilers are cleaned either to rub thoroughly graphite into all the water surfaces of the shell and tubes, or to put several pounds of graphite in the water and allow it to settle on the surfaces. It is found that much less scale will adhere to parts of the boiler coated with the graphite, and the scale that does form may be more easily removed than from uncoated surfaces. Different kinds of graphite are available for this purpose, and various manufacturers make positive claims for the superiority of the different kinds of graphite, although most of them are admitted to be beneficial to a certain degree. At any rate, a good form of graphite is rarely found detrimental to a boiler, although boiler troubles are often attributed to its use which really are caused by some other circumstance entirely immaterial to the use of the graphite. WATER TENDER.

New York.

FOR TRADE PRESS EFFICIENCY.—President H. M. Swetland, of the Federation of Trade Press Associations in the United States, announces that the programme has been completed for the eighth annual convention at the Hotel Astor, New York, Sept. 18 to 20. Acceptances are in hand from over sixty speakers of national reputation in the manufacturing, selling, advertising and publishing fields. There will be fifty 10-minute addresses at the Editorial, Circulation, Advertising and Publishing Symposiums on vital questions affecting all those who have dealings with the business press of America. Other features of the convention will be an exhibit of successful class, technical and trade journal advertising campaigns; a big business meeting, at which will be told the inside stories of the big trade paper publishing successes, and an inspirational mass-meeting, with addresses by representative business and professional men on subjects of live interest to editors, publishers and advertisers. All the regular sessions of the convention will be open, but tickets must be secured for the inspirational mass-meeting. These may be obtained from any member of the Federation, or from W. H. Ukers, chairman of the committee on arrangements, 79 Wall street, New York.

Marine Articles in the Engineering Press

Fire Extinguishers for Ships' Use.—By Naval Constructor Henry Williams, U. S. N. The recent adoption of fuel oil for naval vessels has augmented in a new direction the menace of fire, and, consequently, fire extinguishing apparatus capable of dealing with the dangers occasioned by the presence of fuel oil and fuel gasoline (petrol) must be provided. The subject of fire extinguishers is therefore taken up in a most comprehensive manner, every possible type of fire extinguisher being considered, beginning with water, sand, hand grenades, dry powder extinguishers, and then taking up the chemical fire extinguishers, heavy gas extinguishers, carbon tetrachloride extinguishers and the foam extinguishers, describing in detail the various kinds of apparatus, the methods of using and the results obtainable in so far as they have been shown by practice. 10 illustrations. 6,500 words.—*Journal of the American Society of Naval Engineers,* February.

The Motor Ship in Service.—The countless rumors to the effect that the large Diesel-engined motor ships are continually encountering serious troubles have led the writer to investigate the records of the principal motor ships since entering regular service. Such investigations disclosed the fact that most of the rumors are unfounded, and that the vessels are performing their regular service for the most part uninterrupted and with conspicuous success. Where troubles are experienced they are usually of a minor character and detract little from the value of this type of propulsion. The records investigated comprise practically all the large motor ships in service, and the information obtained is sufficient to show that any suggestion of general unsatisfactory operation of oil engine-driven vessels is entirely without real foundation. As a matter of fact, the success attained has been up to expectations, and the majority of the ship owners state that the commercial aspect of the vessels has been particularly pleasing. 2,600 words.—*The Motor Ship and Motor Boat,* June 26.

Scientific Ship Designing.—By Rear Admiral Casper F. Goodrich, U. S. N. This article, while primarily a review of the book by Sir Reginald Custance, R. N., entitled "Ship of the Line in Battle," gives some interesting comments on the subject under discussion. The author heartily recommends the book as something which every naval officer interested in new designs should read and carefully digest. It is not a history of armored ships, but a careful analysis of actions between them and between ships and fortifications made from the standpoint of strategy as well as of tactics, with a view to determining that relation between the military qualities of the fighting ship which is justified by history. The theorems which Sir Reginald draws and the problems he proposes are as follows: In a sea fight the object is at all ranges, and in a given time to strike blows greater in number than those received. Each blow must be effective but not unnecessarily powerful, since the use of a gun heavier than is necessary means a reduction in the number of guns carried, and therefore in the number of blows struck. The armaments of each ship should be sufficient, but not more than sufficient to do the work, as otherwise power would be wasted and her destruction would involve the loss of an excessive proportion of the total fleet. In his attempts to prove the above theses, Sir Reginald challenges the efficiency of the all-big-gun ship which has met with such general approval, and suggests that warship designers should not be hasty in rejecting the composite armament characteristic in the fighting ship which was developed through a century of naval warfare. By adhering strictly to the all-big-gun ship that well-balanced proportion between the important characteristics which history has always approved is destroyed, and it is suggested that methods of design be revised and the lessons taught by history be more thoroughly taken to heart. 2,700 words.—*United States Naval Institute Proceedings,* June.

White Star Liner Ceramic.—The *Ceramic,* built by Harland & Wolff, Ltd., for the Australian service of the White Star Line, is 674 feet 9 inches long over all, 655 feet long between perpendiculars, 69 feet 5 inches extreme breadth, 48 feet depth to upper deck, about 9,000 indicated horsepower, with a gross tonnage of 18,500. There are seven steel decks and twelve transverse watertight bulkheads carried to the upper deck, besides a cellular double bottom extending throughout the length of the vessel. Thirteen large insulated compartments are provided for the carriage of perishable cargo, comprising three holds and ten 'tween decks of a total capacity of over 310,000 cubic feet. The 'tween decks, in addition to the usual arrangement of brine grids, are fitted with air return and delivery trunks for the circulation of cold water at about 34 degrees for the carriage of fruit, etc. The refrigerating engines and accessories are located on the orlop deck on each side of the reciprocating engine room. The engines consist of two Hall's horizontal duplex CO_2 machines, each of which contains two complete units capable of independent working, so that actually four refrigerating units are provided. Accommodations are provided for 600 passengers ordinarily, with arrangements for a possible extension for a further 220 passengers. The propelling machinery for driving the triple screws consists of two sets of reciprocating engines driving the wing propellers and one low-pressure turbine driving the center propeller. The reciprocating engines have cylinders 26½, 42, 47½ and 47½ inches diameter by 4 feet 3 inches stroke, using steam at 215 pounds pressure. The turbine is of the Parsons type, designed to operate in the ahead direction only and uses the exhaust steam from the reciprocating engines. Steam is supplied by six double-ended boilers, 15 feet 6 inches diameter by 19 feet long, working under natural draft. The electric plant consists of three main engines and dynamos, supplied by W. H. Allen, Son & Company, Ltd., each having a capacity of 74 kilowatts at 100 volts. In addition, there is one 75-kilowatt Lawrence-Scott generator, driven by a four-cylinder Diesel oil engine, manufactured by Burmeister & Wain, at Glasgow. This is situated in a separate compartment on the upper deck level above the waterline at the after end of the ship, forming a source of supply for electric light and power independent of the main generating engines in case of emergency. A complete system of ventilation is installed, consisting of seventeen powerful Sirocco electrically-driven fans. 7 photographs. 2 plates. 5,500 words. —*Shipbuilding and Shipping Record,* July 3.

More Ships than Ever Before.—By Edward Neville Vose. Figures are quoted from Lloyd's Register of Shipping showing that the world's equipment for ocean transportation is now increasing at a more rapid pace than ever before in the history of maritime commerce. The immediate cause of this remarkable activity in shipbuilding is attributed to the fact that ship owners for the last two or three years have been making very handsome profits, which in turn is due to several causes, such as the enormous development of the world's commerce on account of both the increase in manufacturing and the exploitation and development of many portions of the world where hitherto the exports and imports have been very small. Other reasons for the unprecedented growth of shipping are the vast migration of the races from the overcrowded East to the fertile lands in the West, the vast expansion of tourist

traffic and also the approaching completion of the Panama Canal. The immediate effect of the latter cannot be prophesied with any degree of certainty, but the author points out the amount of tonnage which is available for service through the Panama Canal from practically every maritime country. The impression is gained from the author's treatment of this question that most of the large steamship companies in England, Germany, France, Italy, Sweden and Japan are eagerly seeking opportunities to extend their traffic through the canal, while steamship companies of the United States, although their combined tonnage is the second largest in the world, are doing very little toward the development of Panama traffic. There is no question but that the volume of shipbuilding now in the course of completion will make this year the record shipbuilding year in practically every country in the world except the United States. The blame for the inactivity in the United States is attributed by the author to its obsolete navigation laws. 28 illustrations. 5,500 words.—*The World's Work,* August.

The French Battleship Courbet.—In comparing the battleship *Courbet,* built at the Government Dockyard at Lorient, with the English battleship *Orion,* the main details of the new French war vessel are disclosed. The principal dimensions are: Length, 546 feet; breadth, 88½ feet; draft, 29 feet, for a displacement of 23,100 tons with 900 tons of fuel on board. The machinery consists of Normand boilers and Parsons turbines, designed for 28,000 horsepower. The main armament consists of twelve 12-inch guns arranged in six barbettes. The secondary armament includes twenty-two 5.5-inch guns and four 3-pounders. The main armor belt is 11 inches thick, reduced to 7 inches at the ends and surmounted by a strake 7 inches thick amidships. 3 illustrations. 570 words.—*Engineering,* July 11.

Steam Trials of the Chilian Torpedo Boat Destroyer Almirante Lynch.—The Chilian torpedo boat destroyer *Almirante Lynch* is the first of six similar vessels ordered from Messrs. J. Samuel White & Company, Ltd., of East Cowes, Isle of Wight. They are 330 feet long over all, 320 feet long on the waterline, with a molded breadth of 32 feet 6 inches and a molded depth of 21 feet. The designed draft approved for the trial was 9 feet 9 inches, at which the vessel displaced 1,530 tons. Propulsion is by Parsons turbines, aggregating 30,000 horsepower, mounted on three shafts. On the full power trial over the measured mile at Skelmorlie on the Clyde, the designed horsepower was exceeded, the mean speed being 31.7 knots and on the six hours' run 31.85 knots. 750 words.—*Engineering,* July 18.

Hydraulic Dredging on the Upper Mississippi River.—By R. Monroe. To obtain a depth of 6 feet at low water on the Mississippi River, between St. Paul, Minn., and the mouth of the Missouri River, the Government is confining the low water flow in the river by closing side channels and building wing dams from the shore into the stream to the proposed edge of the low water channel. The width of this channel varies from 300 feet at St. Paul to 1,400 feet at the mouth of the Missouri River. This work, together with the removal of an immense amount of sand and silt brought into the Mississippi from side streams, forms a wide field for the use of the hydraulic dredge. Three 18-inch dredges were completed last year by the United States, and there are now in this district eight dredges, all of which are essentially similar, the principal difference being the size of the boiler and engine details. Each dredge consists of a centrifugal sand pump connected by rope drive to a steam engine, a swinging suction pipe supported by a catamaran, and about 500 feet of discharge pipe supported by pontoons. The main details of the dredging plants in operation in this district are given, including the first cost of the dredge and pipe line, also the exact cost of operation, the dredging capacity and the cost per cubic yard dredged. The costs, capacities and dredging data are of exceptional value, being complete in every respect. 2 illustrations. 3,000 words.—*Engineering News,* July 24.

The Story of the Anchor Line.—The Anchor Line is more closely identified with the city of Glasgow and the shipbuilding industry of the Clyde than any other line flying the British flag. It was started by a firm of ship brokers and merchants, and the first vessels operated under the Anchor flag were sailing vessels, which were sent out on ventures to Bombay and in the St. Lawrence trade. In 1854 the Anchor Line opened a steamship service between Glasgow and Lisbon. The Lisbon branch of the trade soon expanded into the Mediterranean, and to meet this expansion three more vessels were required. Meanwhile, the vessels operated in the Canadian service were converted into steamships, and during the winter, when navigation on the St. Lawrence was closed, these vessels were sent to New York, which within a few years became the main transatlantic port of the line. All this happened before the early sixties, but beginning with 1864 the expansion of the line to the Mediterranean, the North Sea, and finally after the opening of the Suez Canal, to India, progressed rapidly. Direct Calcutta service was established in 1882. At the end of the nineteenth century new and larger vessels were placed in the Bombay, Calcutta and New York services, and in recent years an arrangement has been made by the Anchor Line with the Cunard Company for the New York service and with the Brocklebank Line for the Indian service, so that there is now a large measure of community of interests between these lines. The Anchor Line has built no less than eighteen new steamships of 118,000 gross tons since its conversion from a private undertaking, and with its new allies forms part of a large and important organization which is entirely under British management and control. 8 illustrations. 1,700 words.—*Marine Engineer and Naval Architect,* August.

The Norwegian-American Liners Kristianiafjord and Bergensfjord.—Messrs. Cammell, Laird & Company, Ltd., of Birkenhead, have built to the order of the Norwegian Shipping Company, Den Norske Amerikalinje, Christiania, the twin screw passenger and emigrant steamers *Kristianiafjord* and *Bergensfjord,* to be placed in regular service between Christiania and New York under subsidy from the Norwegian Government. The ships, of 11,000 gross tons and 17 knots speed, are 510 feet long between perpendiculars, 61 feet molded breadth, 40½ feet depth, molded to shelter deck, and 26 feet maximum draft. Subdivision of the hull is by a cellular double bottom and nine transverse watertight bulkheads. The construction of the hull and the accommodations for passengers are described in some detail, illustrated with drawings and photographs. 105 first class, 216 second class and 700 third class passengers are carried. Heating and ventilating is carried out on the thermo-tank system, there being twelve thermo-tanks on each vessel in addition to five exhaust fans for special purposes. The electricity is supplied by three 60-kilowatt dynamos. Lifeboat accommodations provide for all on board, the boats being stowed under double-acting Welin davits. Ten derricks, worked by ten 7-inch by 10-inch steam winches, are provided for handling cargo, together with a heavy derrick at the foremast. Propulsion is by two sets of quadruple expansion engines, designed to develop 8,500 indicated horsepower at 95 revolutions per minute. The cylinder diameters are 26, 37½, 53 and 75 inches, respectively, and the stroke 51 inches. Steam is supplied by eight single-ended boilers, 16 feet diameter by 11 feet 8 inches long, designed for 220 pounds working pressure and fitted with Howden's system of forced draft. 8 illustrations. 1,750 words.—*The Shipbuilder,* August.

New Books for the Marine Engineer's Library

Boilers and Boiler Works

STEAM BOILERS. By E. M. Shealy. Size, 6 by 9 inches. Pages, 356. Illustrations, 185. New York, 1912: McGraw-Hill Book Company. Price, $2.50 net.

The author of this book, who is an assistant professor of steam engineering at the University of Wisconsin, has had extensive experience in teaching this subject by correspondence in the Extension Division of the University. The book, therefore, is the result of well-matured plans to produce a suitable text for instruction by mail as developed through actual experience. As it is written primarily for correspondence students, it is intended particularly for the use of firemen and others who may be in responsible charge of boiler rooms. With this object in view the author has dealt very sparingly with the actual construction and calculations for strength of boilers. Only about thirty pages are devoted to this subject, as only the essential details and calculations are given. The first two chapters contain comprehensive descriptions of various types of boilers. Then follows the part devoted to boiler calculations, stays and staying. The remainder of the book is devoted to the discussion of heat and work, the properties of steam, evaporation, fuels, combustion, boiler settings, piping, fittings and accessories, as well as the inspection, care and testing of boilers.

LAYING OUT FOR BOILER MAKERS AND SHEET METAL WORKERS. Second Edition. Size, 10 by 13 inches. Pages, 305. Illustrations, over 600. New York, 1913: Aldrich Publishing Company. Price, $5.

One of the most important operations in a boiler shop is the laying out of the various parts of boilers, stacks, tanks and other sheet metal work. This work requires considerable technical knowledge involving a thorough understanding of the elementary principles of geometry, mechanics and elementary mathematics, although a complete mastery of such subjects is not essential. The most common layouts require the development of cylindrical, conical and other curved surfaces, as well as the determination of the intersection of these surfaces when the article to be manufactured is in the shape of an elbow or irregular transition piece. In this book the practical application of the principles involved in the laying out of such work is explained by numerous examples, including an explanation of the various cal ulations which are necessary to determine the proper size of the different parts of the boilers, tanks, etc.

Most of the material in the book is reprinted from *The Boiler Maker,* and the first edition, which contained eight chapters covering the subject of laying out, triangulation, how to lay out a tubular boiler, how to lay out a locomotive boiler, how to lay out a Scotch boiler, repairing locomotive and other types of boilers, the lay out and construction of steel stacks and miscellaneous problems, has been amplified in the second edition by the addition of 113 new pages fully ilustrated, a large part of which, including forty-four new laying out problems, is a continuation of the last chapter in the first edition on Miscellaneous Problems. There are also two additional chapters, one on miscellaneous calculations showing how to figure the strength and efficiency of riveted joints, the area of circular segments and the cost of boiler construction, and a chapter on Tools for Boiler Makers and Their Uses, in which can be found many practical hints as to the proper way to use the ordinary tools and to operate the more complicated machine tools.

This book is recommended as a valuable aid to anyone engaged in the layout and construction of boiler and heavy sheet-metal work, and especially to those who are seeking advancement in the boiler-making trade, as promotion to the position of layerout is one of the most important steps in the boiler maker's climb to the top of his profession.

Wireless Telegraphy

MANUAL OF WIRELESS TELEGRAPHY AND TELEPHONY. Third edition. By A. Frederick Collins. Size, 4⅞ by 7⅜ inches. Pages, 300. Illustrations, 129. New York, 1913: John Wiley & Sons. London: Chapman & Hall, Ltd. Price, $1.50.

A HANDBOOK OF WIRELESS TELEGRAPHY. By James Erskine-Murray, D. Sc. Fourth edition. Size, 5½ by 8¼ inches. Pages, 442. Ilustrations, 200. New York, 1913: D. Appleton & Company. Price, $3.00 net.

THE YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1913. Size, 5½ by 8¼ inches. Pages, 564. Numerous illustrations. London, 1913: Marconi Press Agency, Ltd. Price, 2/6 net.

These three books, while quite different in character, cover the field of wireless telegraphy and telephony very comprehensively. The first, which is a revised and enlarged edition of a book which has met with much favor, is a practical treatise of the subject giving detailed and explicit instructions for wiring the various types of sending and receiving apparatus now in general use, the adjustment of the instruments, tuning and syntonizing the circuits, testing the devices and finally explaining the management of ship and shore stations.

The second book, while a somewhat lengthy treatise on the subject of wireless telegraphy, does not pretend to be an encyclopedia, nor, on the other hand, a simple exposition of the subject for the benefit of the lay mind. Rather it is intended for the use of those who have some familiarity with both the theory and practice of wireless telegraphy and who can, therefore, comprehend a more technical book to better advantage. There are twenty-one chapters in the book, many of the chapters being devoted to a special part of the apparatus, or a special system of wireless telegraphy. The theory of transmission is gone into quite extensively, and, in fact, no subject is dismissed until its various relations to the science have been thoroughly discussed. A valuable feature will be found in the final chapter, which contains data which are difficult to find elsewhere, dealing with the inductance of helices, capacity of condensers of various forms and sizes, resistance of various conductors to high frequency currents and similar numerical quantities required in the design of radio-telegraphic apparatus.

The third book under review is a new departure, and is issued for the first time this year. The aim of the publishers has been to produce a year book which will be indispensable to those concerned in wireless telegraphy whether technically or commercially, and which will contain information sufficient to make the immense variety of matters relating to the subject intelligible to the general public. The Year Book opens with a calendar which is followed by a concise chronological record of the progress of wireless telegraphy since 1896. Next follows the administrative section, which is considered by the publishers as one of the most important parts of the book, as it contains the London Convention of 1912, the laws and regulations of the principle countries concerning wireless telegraphy, all carefully prepared in English; then there is a complete list of land and ship stations of the world, with their call letters, ranges, wave lengths and the nature of the service, hours of opening and changes set out in a convenient form which makes reference easy. A technical section is provided containing articles contributed by some of the leading experts in this field.

ENGINEERING SPECIALTIES

100 Horsepower Nlseco Diesel Engine

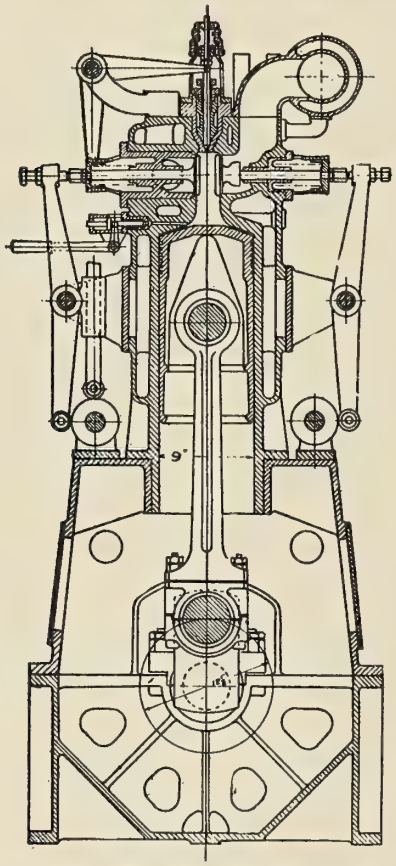
To meet the demand for a simple, durable, reliable Diesel engine of approximately 100 horsepower for use in yachts, fishing boats, small tugs, etc., the New London Ship & Engine Company, Groton, Conn., has developed the four-cycle, 100-120 horsepower marine engine illustrated, and has produced it at a cost which compares very favorably with that of gasolene (petrol) engines suitable for the same service, an achievement that has been considered by engineers abroad as wellnigh impossible. The engine has four working cylinders, a 9-inch bore and a 12½-inch stroke, with the usual arrangement of inlet, exhaust and fuel valves. Cylinders numbers 2 and 3 are arranged for air starting. The engine is not reversible, as for power of this size it is more practicable and convenient to use a reverse clutch, following the usual practice with gasolene engines in motorboats. The air compressors are of the usual two-stage type, and are driven by one of the cranks on the main crankshaft. Another very novel feature is in connection with the fuel-supply system, which has been patented by the New London Ship & Engine Company. Only one pump is used, and this is made so durable and strong that there is little chance of disarrangement and no opportunity for trouble by operators changing adjustments, since there are no adjustments to change. Circulating water is furnished by means of a centrifugal pump. Mechanical force feed oilers are used. The engine is very economical with lubricating oil.

The first time the engine was started, when placed on the test stand, it immediately developed 115 horsepower. It has since developed as high as 130 horsepower, but these are overloads, and it should not normally be run at more than 100 horsepower, for which it was designed. The fuel consumption varies from .5 to .6 pound per horsepower hour, depending upon the load and other conditions. The engine has been used for driving the machinery in one of the shops of the New London Ship & Engine Company, where the load varies from 60 to 120 horsepower. The governor consists of centrifugal weights in the flywheel, and controls the engine very satisfactorily under the great variations of load in the machine shop, due to the use of electric-driven air compressors and of some very large machine tools. The same type of governor will be supplied on all engines, as when the clutch is used a governor is very desirable on an engine as large as this.

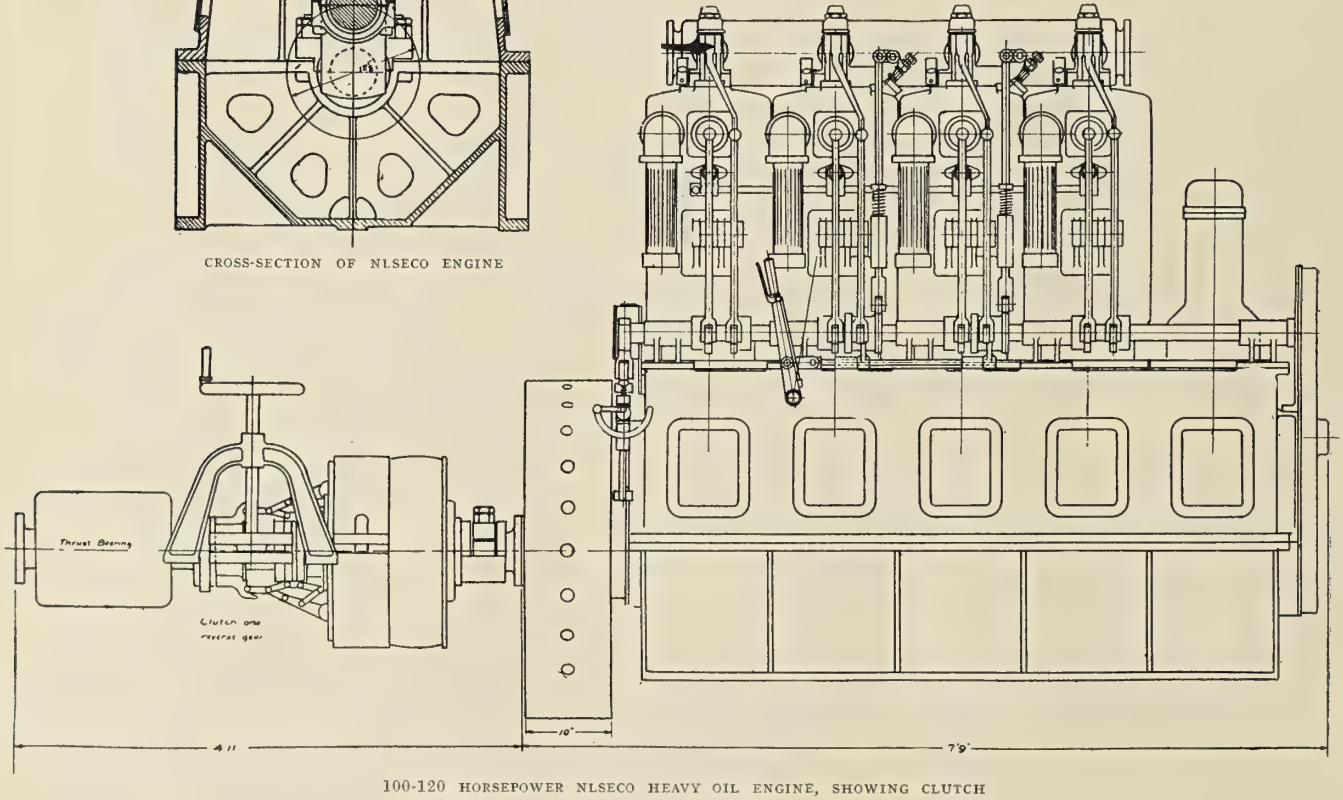
This type of engine is also built in six-cylinder units, developing from 150 to 180 horsepower. Both the four-cylinder and the six-cylinder engines, with cylinders of this size, run at 350 revolutions per minute.

The operation of the engine is easily understood by men who were previously familiar only with gasoline (petrol) engines, and is so very simple that there is little danger of its getting out of order in service. The particular engine in question was erected by a gasoline (petrol) engineer who had never before seen a Diesel engine, and has since been operated entirely by him with most satisfactory results.

While this type of engine was designed primarily for marine use, especially for Pacific Coast work, it is also suitable for



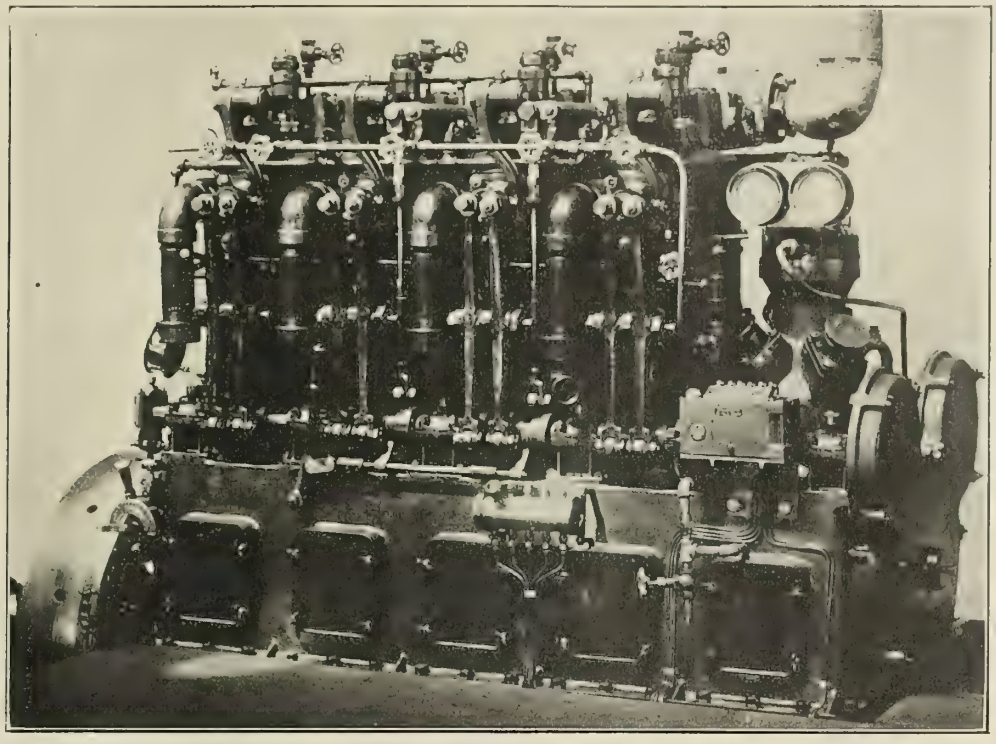
CROSS-SECTION OF NLSECO ENGINE



100-120 HORSEPOWER NLSECO HEAVY OIL ENGINE, SHOWING CLUTCH

use on board ship for driving auxiliary machinery, and for small lighting plants on shore.

The builders also propose to build a larger size engine of 50 horsepower per cylinder for similar uses.



NLSECO HEAVY MARINE ENGINE

Portable Pump Operated from Incandescent Lamp Socket

A portable electrically driven pump, with a capacity of 100 gallons per minute, is made by the Edwards Manufacturing Co., of Cincinnati, Ohio. The weight of the pump, including the motor, does not exceed 125 pounds. It is claimed by the

EDWARDS PORTABLE PUMP

makers that it will operate regularly up to its maximum capacity on current from an incandescent lamp socket. The working parts of the Edwards electro-portable bilge pump, made of brass, operate on ball bearings and are self-lubricating. There are no valves to take care of, and no possibility of freezing, the water automatically draining out as soon as the current is shut off. The motor is fitted to the exhaust tube, and sustains its own weight. It is claimed by the makers that this pump needs virtually no attention. There is no bearing on the shaft, and, consequently, no wear on the parts. It can be installed in working order instantly, and is quite simple to operate.

Another electrically driven bilge pump is built by the Edwards Manufacturing Co. for heavy work. This pump has a capacity of 500 gallons per minute. The construction is similar to that of the smaller pump. Two of these heavy duty pumps have been installed by the Louisville and Cincinnati Packet Co., and are said to be giving perfect satisfaction.

Rivet Sets for Pneumatic Hammers

One of the difficulties experienced by the manufacturer of machine-turned sets is the general lack of uniformity in the steel itself, either in chemical composition or in the heat treatment. Forged rivet sets overcome this difficulty. They have made some wonderful records for service and endurance and are becoming more popular every day. The Chicago Pneumatic Tool Company, Chicago, Ill., has installed up-to-date furnaces and power hammers and are turning them out in great quantities. With the aid of electric pyrometers they are able to preserve uniformity in heat treatment, thus placing entirely within their control one of the vital features of their construction. The general demand for rivet sets is for those cupped for button and conical heads, and which they have designated as standard. But they are prepared to furnish them in all shapes and sizes for special work.

Improved Flow Meter

To meet the requirements of a strong mechanical meter, which can be used not only as a test instrument, but as a stationary meter for the continuous measurements of either liquids, gases or vapors, the instrument illustrated has been brought out by the General Electric Company, Schenectady, N. Y. An exterior view of the meter is shown in Fig. 1, and the mechanism in Fig. 2.

The body of the flow meter consists of an iron casting cored out so as to form one leg of a U-tube and a reservoir for mercury, the outer leg of the U-tube being formed by a pipe which opens into the reservoir. The pressure on the surface of the mercury varies with the rate of flow of the fluid being measured, as will be explained later.

A float *O* rests on the surface of the column of mercury in the body of the meter and rises and falls with the corresponding changes in its elevation. The float is geared by rack *P*

FIG. 1

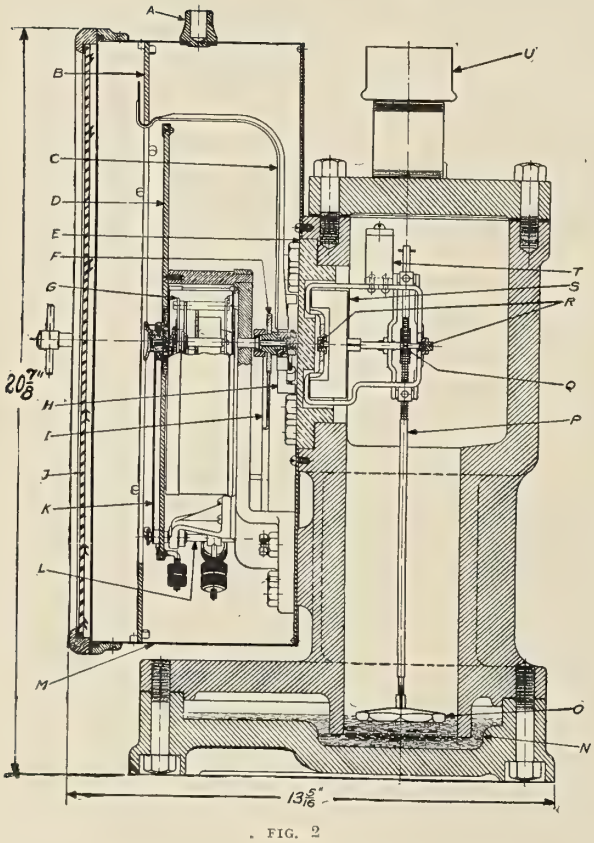


FIG. 2

and pinion *Q* to a horizontal shaft *R*, which carries a permanent U-shaped magnet *S*. The poles of this magnet face a copper cap *E*, which closes an opening into the meter body. The remaining parts of the meter's mechanism are mounted on the outside of the cap. A shaft, parallel to the one on which the magnet inside the body is mounted, carries a smaller magnet *H*, whose poles are opposite those of the larger magnet, this arrangement tending to transmit motion through the cap without piercing it with a shaft, and thus the difficulty of packing such an entrance to prevent leakage is avoided. As the poles facing one another are of opposite polarity, the magnetic flux binds them together, so that a movement of the magnet inside the body involves a corresponding movement of the one outside, the latter moving the indicating needle *C* and the recording pen *K* through suitable mechanism.

The pressure which moves the column of mercury in the U-tube is obtained, for pipes two inches and greater in di-

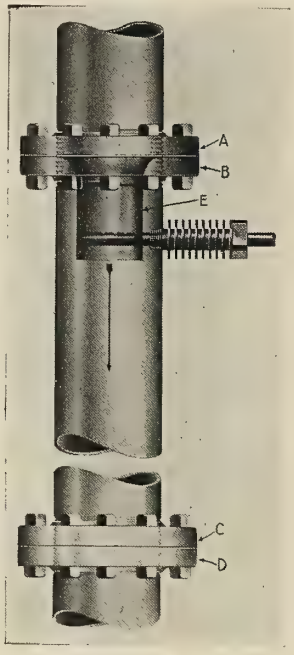


FIG. 3

ameter, by inserting a modified form of Pitot tube, termed a "nozzle plug" (shown in Fig. 3), directly into the pipe line. This can be done without disturbing the piping, except where it is desired to increase the rate of flow at the point of metering, in which case a special pipe reducer (*E* in Fig. 3) is provided. This reducer is made of brass, and has a long throat with rounded entrance terminating in a flange. The flange is inserted between the pipe flanges and is held in place in the same manner as a gasket. A special nozzle plug is supplied with the pipe reducer.

The nozzle plug is a tube with two separate conduits in it, each conduit having a set of openings, the two sets being on diametrically opposite sides of the tube. Those on the side of the tube facing the flow are called the leading openings, while those on the opposite side are called the trailing openings.

The flow against the leading openings in the nozzle plug sets up a pressure in the leading conduit which equals the static pressure plus a pressure due to the velocity head. The flow past the trailing openings causes a suction which lowers the pressure in the trailing conduit. As these two conduits are connected to the U-tube by ¼-inch pipes, the column of mercury is affected by this unbalanced pressure, causing a movement of the float. The leading set of openings in the nozzle plug extends approximately across the pipe diametrically, so as to make the velocity pressure transmitted to the meter the mean velocity rather than that at a single point in the pipe.

The chart on which the pen records are made is rotated by a clockwork at a suitable speed. The recording pen sweeps the chart radially, and the resulting curve shows the rate of flow at any time during the chart cycle.

The integrating device consists of a stationary flow-rate planimeter driven by the chart paper. The angular position of the planimeter wheel is determined by a cam connected to the shaft of the recording pen and moving with this pen. The planimeter dials read in arbitrary units, which, multiplied by a constant furnished with the meter, gives the flow in the de-

sired unit. This device is extremely simple, and there is practically no danger of its getting out of adjustment.

For pipes less than two inches in diameter, an orifice tube, which is a brass pipe tapered internally from both ends so as to form a restricted opening at the middle of the tube, is provided, and it must be incorporated in the pipe line. One leg of the U-tube is connected to the orifice tube near its end, and the other leg to its middle point, where the greater velocity at the orifice will give a reduced pressure in the pipe leading to the U-tube.

To meet the requirements of the different classes of service and the various conditions met with, the meter can be made up in four different ways: first, as a recording or curve-drawing instrument; second, with both indicating scale and recording chart; third, with recording chart and integrating dials; fourth, with indicating scale, recording chart and integrating dials, an exterior view of which is shown in Fig. 1.

Some of the large companies have found that flow meters pay for themselves in a short time. With their use the record of the performance of the apparatus shows whether it is operating at the greatest efficiency or not. Surprising conditions have been brought to light by their use, showing at once how indispensable they are. A flow meter on each boiler of a battery running in multiple on the same header shows just what each is doing, and so permits adjusting the operation of the units so that each will carry its full share of the load. They also indicate immediately whether the load has increased or the steaming rate of the boilers decreased, in case the steam pressure begins to drop. Moreover, from the graphic record of steam pressure, it is possible to determine whether the method of firing can be made more efficient or not. In a big plant, the use of flow meters makes it possible to segregate the costs of the steam, water, etc., so that each department can be charged with its share of the costs of these, and a study of the feed-water chart will determine the rate at which the feed water should be supplied to secure the highest degree of efficiency.

"DBS" Spur Reducing Gear

David Brown & Sons (Hudd.), Ltd., Lockwood, Huddersfield, manufacture reduction gearing for the transmission of power for various purposes. For spur or double helical gears to be satisfactory, however, they must be properly mounted with good, substantial bearings, as close as possible to the

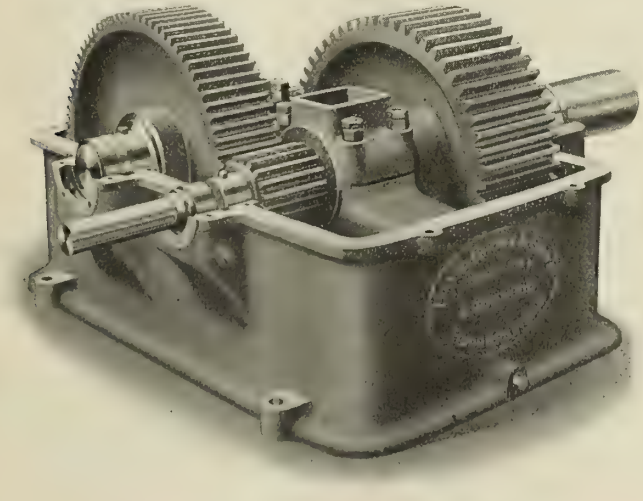


FIG. 1.—"DBS" STANDARD DOUBLE REDUCTION GEAR

gears, and, on account of the strains tending to separate the two shafts due to the load being transmitted, it is also essential for the bearings to be rigidly housed in the case, otherwise the center distance is liable to alter, or the shafts themselves become out of parallel. Neglect of these points results in rapidly wearing, noisy and unsatisfactory gears. For this reason, David Brown & Sons recommend, whenever possible, the standard single or double reduction gears, such as shown in Fig. 1, which have been specially designed to withstand hard usage. The reduction cases are provided with either spur or

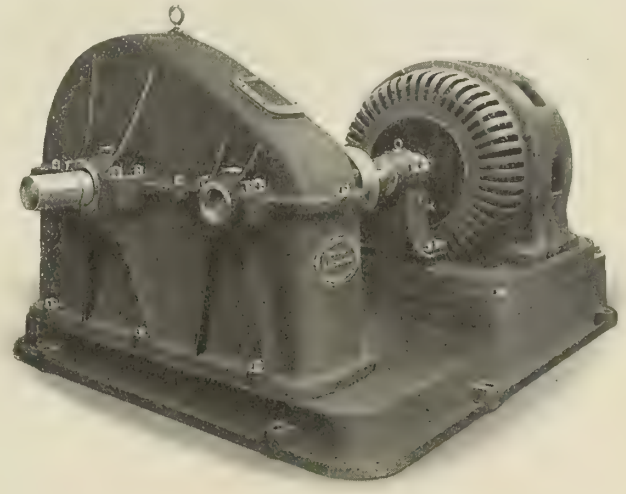


FIG. 2.—28-IN. SINGLE SPUR REDUCER, COUPLED TO 200 HORSEPOWER MOTOR

double helical gearing, according to the speed at which they have to run and the class of work for which they are intended. The cases are complete in themselves, and only require to be coupled to the motive power at one end and to the machine to be driven at the other. This style of mounting also insures efficient lubrication and the exclusion of all dust and dirt from the gears. A typical set is illustrated in Fig. 2 coupled to a 200-horsepower motor.

Obituary

CAPT. HENRY C. DAGGETT, for more than thirty years in command of vessels of the Savannah Line, died recently at his home in Brooklyn at the age of seventy. When only nineteen years old, Captain Daggett was given his first command of a full-rigged ship, and since that time he has been one of the best-known captains in coastwise service, being a familiar figure at the ports of the Atlantic seabord of the United States.

J. MERTON TAYLOR, president of the Taylor Instrument Companies, Rochester, N. Y., died July 31 following a short illness. Mr. Taylor was born in Rochester fifty-seven years ago, and was a son of the late George Taylor, founder of the Taylor Instrument Companies. He was associated with this concern throughout his life, becoming president in 1910. He was an example of the highest type of business man, and as such was respected and held in highest esteem in the business world.

VERNON H. BROWN, for many years agent of the Cunard Steamship Company, died at his home in New York, Aug. 5, at the age of eighty-one. Mr. Brown was in the service of the Cunard Line for nearly thirty years, and was the first American to hold the post of manager. His first experience in the shipping business was as an apprentice in the firm of Sampson & Tappan, owners of a famous fleet of clippers in the East India trade. When he became of age, Mr. Brown went into business with his father, forming the firm of Vernon Brown & Son, of Boston, engaging in the East India trade. Later Mr. Brown came to New York and established the firm of Vernon H. Brown & Company, which continued in the shipping business until a few years ago. He was interested in many important business enterprises as a director and trustee.

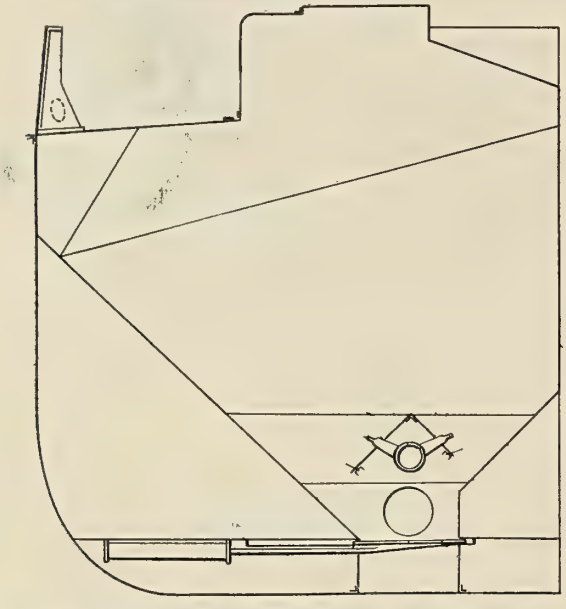
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

1,063,284. DREDGE-HOPPER. JOHN REID, OF NEW YORK, N. Y.

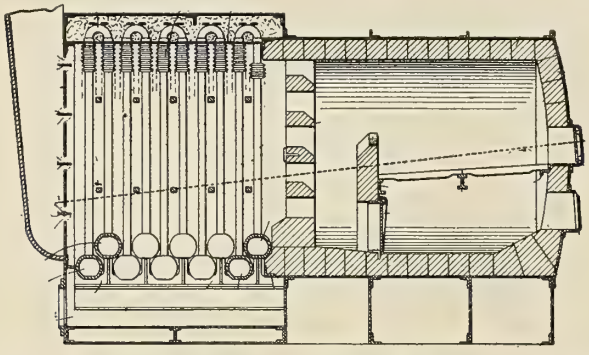
Claim 1.—A dredge hopper, comprising sloping and perpendicular walls leading to a trough portion at the bottom thereof, a protecting roof for said trough portion and discharge openings through the skin of



the vessel at intervals from said trough, and a water pipe arranged under said protecting roof and having spraying nozzles extending into the hopper proper and adapted to keep the dredged material moving. Five claims.

1,064,250. MARINE SUPERHEATER. JOHN PRIMROSE, OF NEW YORK, AND GODFREY HARTER, OF DANSVILLE, NEW YORK, ASSIGNORS TO POWER SPECIALTY COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

Claim 1.—A stack in a marine superheater, the combination of a superheating chamber, a steam superheater therein, a furnace of cylindrical cross section having its rear end connected to the superheating



chamber to discharge hot gases of combustion thereinto, a wall between the superheater and the stack having a plurality of apertures therein and means to close part or all of said apertures whereby a uniform flow of gases through the superheater may be obtained. Nine claims.

1,063,832. MEANS FOR LOADING SHIPS. BERNARD REIVER, OF PHILADELPHIA, PENN.

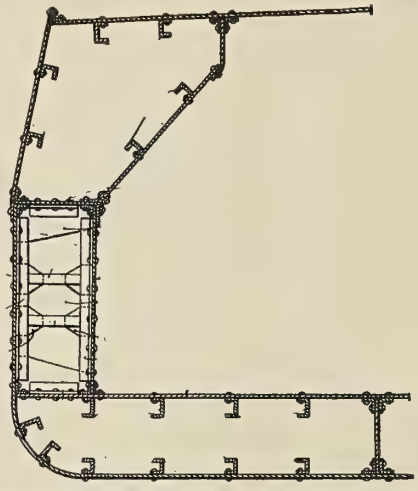
Claim 1.—In means for loading and unloading vessels, a tube connecting two vessels, a lashing cable for connecting the two vessels passing through the tube, and a second tube arranged within the first mentioned tube and adapted to have the load passed therethrough. Two claims.

1,063,804. MEANS FOR CLEANING SHIPS' HULLS. GUSTAV JULIUS KINDERMANN, OF WAYVILLE, SOUTH AUSTRALIA.

Claim 1.—A device for cleaning ships' hulls, comprising two spaced electric motors each inclosed in a casing, each casing being provided with an eye at the end, a pair of eyes on each side, and a spring buffer between each pair of eyes, a shaft between the motors and coupled thereto, a cleaning member mounted on the shaft to turn therewith, and cables attached to the eyes of each of the motors for securing the device to a ship's hull. Two claims.

1,065,549. SHIP. JOHN REID AND GEORGE SIMPSON, OF NEW YORK, N. Y.

Claim.—In combination, a top side ballast tank having a main framing therewithin formed of fore and aft channel irons, a bottom ballast tank having a main framing therewithin, formed of fore and aft channel irons, and buttress framing extending from said bottom ballast tank to said top side ballast tank and forming reinforcing pillar frames at



intervals throughout the length of the ship between said tanks, said buttresses being formed of vertical channel irons extending between brackets connected to said ballast tanks by angle irons and braces crossing between the verticals intermediate of the length thereof. One claim.

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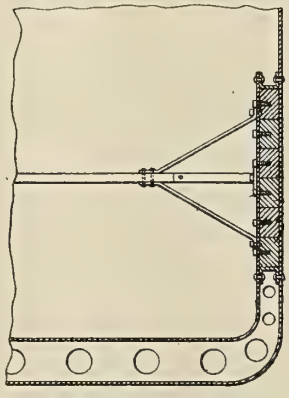
13,114. IMPROVEMENTS IN THE CONSTRUCTION OF NAVIGABLE VESSELS. J. MACNAB OF ISLINGTON, MIDDLESEX.

Claim.—This invention relates to a navigable vessel provided with a double cellular bottom and consists in extending the inner bottom above the waterline substantially parallel with the inside of the hull and inserting between the adjacent faces of the hull and the extended



portion of the inner bottom at some distance above and below the waterline, wooden battens which form a buffer-belt or fender, for protecting the ship when in collision, etc. The battens may be extended around the inside of the hull and an inner skin, which forms a downward extension of the upward extension of the inner bottom, may be provided.

4,729. DEVICE FOR LIFE SAVING IN CONNECTION WITH SUBMARINES. H. BEACH, OF "METHLEY," TOTTERIDGE LANE, WHETSTONE, MIDDLESEX.

This invention relates to submarine vessels having a detachable float, which, in the event of the vessel being accidentally sunk, can be released from a receptacle in which it is normally located and which it seals, and thereby caused to carry to the surface of the water a pipe by which air can be conveyed to the interior of the vessel. The invention comprises the provision of apertures in the float through which water can pass to the interior of the receptacle to allow the float to rise and the adaptation of the catches by which the float is secured to close such apertures when they engage the float and to open the apertures when they are withdrawn from the float to release it.

10,990. IMPROVEMENTS RELATING TO THE CONSTRUCTION OF SHIPS. A. E. SCOTT, C. E., OF WEST HAMPSTEAD, MIDDLESEX.

Claim.—For the purpose of strength and lightness the bulkheads of zig-zag, angled or corrugated section, are stiffened at or about one-third of their unsupported depth from the base by doubling strake, or a plate or bar bent to conform to and riveted to the face of the bulkhead, this stiffening member serving to strengthen the bulkhead against buckling at the level of the center of pressure due to the full head of water dammed by the bulkhead. The member may be of any thickness and depth that may be required to afford the necessary strength to a bulkhead built of zig-zag or corrugated plates of a given thickness.